



A Five-Dimensional Identification Framework for Higher Vocational Entrepreneurship Education

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Abstract. The comprehensive rural revitalization strategy is accelerating the development of advanced entrepreneurial talent through higher vocational education. However, current efforts remain misaligned with the actual needs of rural industrial development. Drawing on domestic and international research on entrepreneurship education models, this paper analyzes existing provisions and rural talent requirements, introducing a Five-Dimensional Identification framework. This framework encompasses rural entrepreneurial mindset, opportunity, business environment, resource, and behavioral identification, with a tripartite indicator system and an evaluation protocol. Validated through curriculum redesign, platform development, and ecosystem building in Tieling, Liaoning Province, this study contributes a validated measurement framework and provides data-driven insights for designing personalized interventions in rural entrepreneurship education, while acknowledging the methodological limitations inherent in the single-group design. It benefits both to theoretical understanding and practical approaches for aligning vocational training with the imperatives of rural revitalization.

Keywords: Five-dimensional identification framework, Rural revitalization, Higher vocational education, Entrepreneurial talent cultivation.

1 Introduction

With the advancement of the comprehensive rural revitalization, the demand for high-quality entrepreneurial talent in rural industrial development has become increasingly critical. As the primary institutions for cultivating technical and skilled professionals, higher vocational colleges (HVCs) have seen a continuous increase in the proportion of rural students within their enrollment. Graduates from these rural backgrounds naturally possess unique advantages when returning to their hometowns to start businesses: they have social resources such as traditional rural connections and local networks, are familiar with local production and living conditions, and simultaneously

hold collective organizational membership status, which provides institutional support for developing new types of rural business organizations, like farmers' professional cooperatives and family farms.

A significant disconnect persists between higher vocational entrepreneurship education and the actual demand for entrepreneurial talent in rural industrial development. On one hand, rural industrial development urgently requires versatile individuals who "understand agriculture, cherish rural areas, and care for farmers". On the other hand, this educational sector faces challenges such as overly broad training objectives, teaching content that is disconnected from rural realities, and practical platforms that are not integrated with field settings. Consequently, graduates find themselves in a supply-demand mismatch—unable to establish themselves in urban areas and ill-prepared to return to rural communities. These issues reflect deficiencies in educational quality and, more fundamentally, a systemic misalignment between the pedagogical system and the imperatives of rural development. Developing a validated framework to assess and guide entrepreneurial education in this context has thus become a critical priority for higher vocational reform.

This study selects Tieling County, Liaoning Province, as its empirical site. The "Tiandiaoya Sweet Potato" industry represents a distinctive "one town, one industry" model, covering 200 hectares of planting area across 11 administrative villages. It supports 112 planting households and produces over 4.5 million kilograms annually. Utilizing farmers' professional cooperatives as educational platforms, the research team developed a "Five-Dimensional Identification" framework to address the aforementioned talent supply-demand imbalance. A three-level indicator system and a corresponding effectiveness evaluation scheme were established. A one-group pre-test/post-test quasi-experimental design (due to the absence of random assignment and a control group) was employed to examine changes in students' entrepreneurial capabilities over a three-year period. After three years of practical application, systematic evaluation data were collected, providing preliminary evidence regarding the framework's utility in this specific context.

2 Higher Vocational Entrepreneurship Education Frameworks

2.1 Domestic Frameworks

Domestic research on higher vocational entrepreneurship education frameworks has achieved fruitful results in recent years. The "Integration of Specialization and Innovation" curriculum framework research^[1] proposed a curriculum reconstruction path of "alternating light and dark" for horizontal integration of specialized and innovative knowledge, "progressive interweaving" for vertical system of specialized and innovative capabilities, and "parallel blending" for three-dimensional enhancement of specialized and innovative qualities. The "Three-Stage, Three-Layer" talent cultivation system research^[2] divided training objects into three layers: seedling layer, backbone layer, and maker layer, and designed the education process as three stages: knowledge initiation, project building, and base realization. The multiple collaborative education mechanism research^[3], based on stakeholder theory, explored multiple collaborative paths for

higher vocational colleges' innovation and entrepreneurship education. The "Triple Helix, Five Chains" fusion symbiosis model research^[4] proposed a "triple helix, five chains" fusion symbiosis model. The PTPF education method research^[5] constructed an education method including four functional blocks: platform construction, learning teams, project practice, and evaluation feedback. The competition-creation fusion education model research^[6] explored the organic integration path of innovation and entrepreneurship competitions with innovation and entrepreneurship education.

2.2 International Frameworks

The EntreComp framework^[7] proposed by the European Union is the most internationally influential entrepreneurship capability framework. This framework defines entrepreneurship capability as "the ability to transform ideas into actions to create value," covering three dimensions and 15 specific capabilities: first, the "Ideas and Opportunities" dimension, including capabilities such as identifying opportunities, creativity, vision, valuing ideas, and ethical and sustainable thinking; second, the "Resources" dimension, including capabilities such as self-awareness and self-efficacy, motivation and perseverance, mobilizing resources, financial and economic literacy, and mobilizing others; third, the "Into Action" dimension, including capabilities such as taking the initiative, planning and management, coping with uncertainty, working with others, and learning through experience. This framework provides a common reference benchmark for entrepreneurship education in various countries.

2.3 Rural Entrepreneurship Talent Demands

However, the comprehensive rural revitalization and rural industrial development have made their demands for entrepreneurial talents clear. On one hand, new agricultural business methods require compound entrepreneurial talents—as agricultural production and operation methods transform from family self-sufficiency to scale, specialization, and industrialization, human resource needs gradually shift from ordinary labor to management talents. New types of business entities such as largescale planting and breeding households, family farms, and farmers' professional cooperatives urgently need compound talents who understand agricultural production technology, business management, and marketing. On the other hand, the digital transformation of rural industries requires entrepreneurial talents with digital literacy. New business forms such as rural e-commerce, live streaming sales, and smart agriculture are flourishing, requiring entrepreneurs to master modern information technology and online marketing skills, and to be able to use digital platforms to expand sales channels and create additional value for local specialties. Furthermore, integrated urban-rural development requires talents familiar with local rural society. Returning to hometowns to start businesses must understand the cultural logic of rural society, grasp the operating rules of acquaintance society, possess the ability to communicate and coordinate with villagers, village collectives, and grassroots governments, and be able to integrate resources and resolve conflicts in the rural field. The core capabilities of rural entrepreneurial talents can gener-

ally be deconstructed into five aspects: rural entrepreneurship Minds mindset identification capability, opportunity discovery capability, environment perception capability, resource integration capability, and action promotion capability.

Nevertheless, current higher vocational entrepreneurship education research and practice need continuous optimization and upgrading. Training objectives need to be more specific—most higher vocational colleges simply position entrepreneurship education as "cultivating students' entrepreneurial awareness and capabilities," lacking specificity for rural particular situations, leading graduates to have entrepreneurial knowledge but not knowing how to apply it to rural realities. Teaching content needs to be closer to rural realities—course content is mostly based on urban entrepreneurial cases, lacking systematic teaching about rural resources, rural markets, and rural policies, making it difficult for students to connect what they learn with rural industries. Practical platforms need to go deep into rural fields—practical platforms such as on-campus entrepreneurship incubators and maker spaces lack substantive connections with rural industries. Students cannot develop entrepreneurial capabilities without real rural environments. The teaching staff needs to be enriched with rural experience, as many teachers lack rural life and work experience.

These observations suggest that targeted research for the specific field of rural revitalization is relatively rare, and most framework designs are based on general entrepreneurial situations, potentially neglecting the special requirements of rural entrepreneurship for talents. This leads to a "two isolated systems" situation between talent cultivation and industrial demand. A clear supply-demand mismatch has formed between higher vocational entrepreneurship education and rural talent demands. Rural industrial revitalization urgently needs a large number of entrepreneurial talents who "can go down, stay, and be useful"; however, higher vocational graduates, despite having the willingness to return to their hometowns, often lack corresponding capabilities. These issues have gradually become key bottlenecks constraining higher vocational education's service to rural revitalization, motivating systematic research in entrepreneurship education oriented towards rural revitalization and the development of the Five-Dimensional Identification framework.

3 "Five-Dimensional Identification" Rural Entrepreneurship Education Framework

Based on the demands for rural entrepreneurial talents, this research proposes the "Five-Dimensional Identification" entrepreneurship education framework. This framework consists of five dimensions: rural entrepreneurship mindset identification, opportunity identification, business environment identification, resource identification, and behavior identification, presenting dual logical relationships of progression and circulation. To achieve the operability and evaluability of the framework, the research team further designed a three-level indicator system.

3.1 The Conceptual Model

Rural Entrepreneurship Mindset Identification: Refers to entrepreneurs' understanding and identification of rural values. This includes understanding the cultural logic of rural society, identifying with the value significance of rural development, forming entrepreneurial visions serving rural areas, and establishing ethical concepts of sustainable development. This dimension responds to the value demands of rural talents, cultivating students' feelings for the countryside, enthusiasm for agricultural studies, awareness of returning to hometowns, and original intention of entrepreneurship. It is the primary task of entrepreneurship education.

Rural Entrepreneurship Opportunity Identification: Refers to the ability to discover opportunities in the rural field. This includes discovering potential value in rural resources, identifying changing trends in rural market demands, grasping development opportunities brought by policy support, and foreseeing innovation space in industrial integration. This dimension responds to the demand for opportunity discovery capabilities in rural industrial development, guiding students to understand agricultural product planting techniques, establish agricultural product brand awareness, possess basic financial knowledge, and understand marketing, logistics, and supply chain common sense to discover and grasp entrepreneurial opportunities.

Rural Business Environment Identification: Refers to the ability to perceive and grasp the entrepreneurial environment. This includes understanding local government policy support systems, grasping cultural norms of rural society, identifying potential partners, and predicting institutional obstacles in the entrepreneurial process. This dimension responds to the demand for environmental adaptation capabilities of entrepreneurs in complex rural environments, cultivating students' knowledge and capabilities regarding key links in the business environment during the return-to-hometown entrepreneurship process, such as licensing and admission, business premises acquisition, public service counseling, labor employment, tax payment, dispute resolution, and fair market competition.

Rural Entrepreneurship Resource Identification: Refers to the ability to integrate various resources under resource-constrained conditions. This includes integrating resources from multiple parties such as government, enterprises, village collectives, and villagers; mobilizing family and social relationship networks; using digital technology to obtain information and support; and looking for local knowledge and traditional skills. This dimension responds to the demand for integration capabilities due to resource constraints in rural entrepreneurship, focusing on cultivating students' entrepreneurial subject awareness and operation management capabilities.

Rural Entrepreneurship Behavior Identification: Refers to the ability to adapt entrepreneurial behavior to rural situations. This includes selecting entrepreneurial models adapted to local conditions, adopting business methods conforming to local culture, forming sustainable entrepreneurial behavior habits, and accumulating entrepreneurial experience through trial and error. This dimension responds to the demand for action capabilities in rural entrepreneurial practice, cultivating students' fault tolerance, error correction capabilities, and execution capabilities.

3.2 The Logical Implications

The Five-Dimensional Identification framework presents dual logic of progressive relationships and circular feedback: concept identification is the starting point, laying the value foundation for entrepreneurship; opportunity identification is the prerequisite, discovering the possibility of entrepreneurship; business environment identification is the guarantee, grasping external conditions for entrepreneurship; resource identification is the key, integrating various elements for entrepreneurship; and behavior identification is the foothold, transforming concepts into actual actions. After entrepreneurial behavior occurs, it brings new experiences and cognition, feeding back to deepen concepts and rediscover opportunities, forming a spiral ascent process of "concept-opportunity-environment-resource-behavior." This logical chain completely responds to the entire process capability demands of rural entrepreneurial talents from value identification to action practice.

3.3 The Framework System Design

Benchmarking against the EU EntreComp entrepreneurship education framework, this research designed a three-level indicator system for the Five-Dimensional Identification framework comprising 5 capability dimensions, 15 capability elements, and 45 specific behavioral indicators (table 1). Each capability dimension contains 3 capability elements, and each capability element corresponds to 3 specific behavioral indicators, forming a complete observable and evaluable indicator system.

Table 1. Five-Dimensional Identification Framework Three-Level Indicator System

Primary Dimension - Secondary Element - Tertiary Behavioral Indicators

1. Rural Entrepreneurship Mindset Identification

1.1 Rural Value Understanding

1.1.1 Able to understand the cultures and operating rules of rural society

1.1.2 Able to recognize the important significance of rural industrial development for rural revitalization

1.1.3 Able to identify with the unique value of rural lifestyles and production methods

1.2 Entrepreneurial Vision Formation

1.2.1 Able to form entrepreneurial visions serving rural areas based on personal advantages

1.2.2 Able to organically combine personal development with rural development

1.2.3 Able to set clear short-term, medium-term, and long-term entrepreneurial goals

1.3 Ethical Concept Establishment

1.3.1 Able to recognize the multiple impacts of entrepreneurial activities on rural communities

1.3.2 Able to balance economic and social benefits in entrepreneurial decision-making

1.3.3 Able to form sustainable entrepreneurial concepts and behavioral guidelines

2. Rural Entrepreneurship Opportunity Identification

2.1 Resource Value Discovery

Primary Dimension - Secondary Element - Tertiary Behavioral Indicators

- 2.1.1 Able to discover potential economic value in rural natural resources
- 2.1.2 Able to identify commercial value in rural cultural resources and traditional skills
- 2.1.3 Able to grasp opportunities for integration and development of rural industrial resources
- 2.2 Market Demand Insight
 - 2.2.1 Able to identify diversified consumer demands for agricultural products
 - 2.2.2 Able to grasp product trends and sales opportunities on ecommerce platforms
 - 2.2.3 Able to foresee growth space in service consumption such as rural leisure tourism
- 2.3 Policy Opportunity Grasping
 - 2.3.1 Able to understand industrial support directions in rural revitalization policies
 - 2.3.2 Able to grasp entrepreneurial opportunities brought by various policies benefiting agriculture
 - 2.3.3 Able to predict impacts of policy changes on entrepreneurial projects and layout in advance
- 3. Rural Entrepreneurship Environment Identification
 - 3.1 Policy Environment Perception
 - 3.1.1 Able to understand local policy systems supporting return-to-hometown entrepreneurship
 - 3.1.2 Able to grasp policies such as tax incentives and financial support related to entrepreneurship
 - 3.1.3 Able to timely obtain policy information and apply it to entrepreneurial practice
 - 3.2 Social Environment Grasping
 - 3.2.1 Able to understand operating rules and interpersonal relationships in rural acquaintance society
 - 3.2.2 Able to grasp effective ways to communicate and coordinate with villagers and village collectives
 - 3.2.3 Able to identify potential collaborators and supporters in rural society
 - 3.3 Institutional Obstacle Prediction
 - 3.3.1 Able to predict licensing and admission issues that may be encountered in the entrepreneurial process
 - 3.3.2 Able to identify obstacles in links such as business premises acquisition and labor employment
 - 3.3.3 Able to foresee institutional risks in links such as tax payment and dispute resolution
- 4. Rural Entrepreneurship Resource Identification
 - 4.1 Multiple Subject Integration
 - 4.1.1 Able to identify and connect with support resources from government departments
 - 4.1.2 Able to establish cooperative relationships with enterprises to obtain technical and market support
 - 4.1.3 Able to integrate village collective resources and villagers' production capabilities

 Primary Dimension - Secondary Element - Tertiary Behavioral Indicators

4.2 Social Network Mobilization

4.2.1 Able to mobilize family and relative relationship networks to obtain entrepreneurial support

4.2.2 Able to use local connections to expand sales channels and cooperation opportunities

4.2.3 Able to build and maintain entrepreneurial support networks through social media

4.3 Digital Resource Utilization

4.3.1 Able to use online platforms to obtain technical information and market data

4.3.2 Able to use digital tools to carry out product promotion and brand building

4.3.3 Able to expand sales channels and customer groups through e-commerce platforms

5. Rural Entrepreneurship Behavior Identification

5.1 Entrepreneurial Model Selection

5.1.1 Able to select suitable entrepreneurial organizational forms according to local conditions

5.1.2 Able to design business methods and models conforming to local culture

5.1.3 Able to select entrepreneurial entry points and scales matching personal capabilities

5.2 Entrepreneurial Action Promotion

5.2.1 Able to formulate feasible entrepreneurial plans and promote implementation step by step

5.2.2 Able to adjust strategies according to actual situations during the entrepreneurial process

5.2.3 Able to continuously invest time and energy to promote entrepreneurial project development

5.3 Entrepreneurial Experience Accumulation

5.3.1 Able to summarize lessons and improve entrepreneurial behavior through trial and error

5.3.2 Able to learn from successes and failures and form personal entrepreneurial methods

5.3.3 Able to transform entrepreneurial experience into teachable knowledge and skills

Instrument Development and Validation. Based on the above three-level indicator system, the research team developed the "Five-Dimensional Identification Entrepreneurial Capability Self-Assessment Questionnaire." Each of the 45 behavioral indicators was transformed into a positively worded statement (e.g., "I can understand the cultural logic and operating rules of rural society") using a five-point Likert scale (1 = completely disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = completely agree).

Expert Review Process. Three entrepreneurship education experts and two rural development practitioners were invited to review the indicators for content validity. Each expert rated the relevance of each indicator on a 4-point scale (1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, 4 = highly relevant). The Content Validity Ratio (CVR) was calculated using the formula $CVR = (n_e - \frac{N}{2}) / (\frac{N}{2})$, where n_e is the number

of experts rating the item as "quite relevant" or "highly relevant" and N is the total number of experts. Items with CVR values below 0.50 were considered for revision. All 45 items had CVR values exceeding 0.60, with an average CVR of 0.78, indicating acceptable content validity. A two-round Delphi process was used; in Round 1, experts provided qualitative feedback; in Round 2, minor wording adjustments were made based on this feedback. A pilot test with 50 students (not included in the final sample) was conducted to assess item clarity and internal consistency; minor wording adjustments were made based on feedback.

Teacher Observation Scoring. For the teacher observation evaluation, two independent observers (both trained in the Five-Dimensional Identification framework) assessed 20 randomly selected students. Observations were conducted independently without communication between observers (blind to each other's ratings). Inter-rater reliability was calculated using the intraclass correlation coefficient (ICC) for the overall scale. The ICC was 0.82 (95% CI [0.74, 0.88]), indicating good agreement.

Reliability. Cronbach's α coefficients for the five dimensions were: Rural Entrepreneurship Mindset Identification 0.89, Opportunity Identification 0.91, Environment Identification 0.88, Resource Identification 0.92, Behavior Identification 0.90. All values exceed the recommended threshold of 0.70, indicating excellent internal consistency. The overall scale reliability was 0.96.

Common Method Bias. Harman's single-factor test was conducted on all 45 items; the first unrotated factor explained 28.7% of the variance, well below the 50% threshold, suggesting that common method bias is not a serious concern.

4 Implementation of the Frame

Since 2020, the research team has leveraged projects such as the Liaoning Provincial Education Science Planning Project, "Innovation and Practice of Skill Talent Cultivation Model for Rural Industrial Revitalization," to conduct a case study in Tieling County. Based on the Five-Dimensional Identification framework, practical approaches to improving higher vocational rural entrepreneurship education have been systematically explored to satisfy the talent demands of rural industry development.

4.1 Local Resources and Preliminary Foundation

Tieling County is a typical agricultural county, with an overall layout of modern agriculture planned as "one belt, two parks, ten bases." The "Tiandiaooya Sweet Potato" industry is a characteristic industry of "one town, one industry" locally. The research team selected Zhenxibao Town, Tieling County as the empirical research area and carried out the case study of entrepreneurship talent cultivation of higher vocational rural students relying on the local sweet potato industry.

The research team has already accumulated rich research foundations: first, completing the "Research on Development Models of Farmers' Professional Cooperatives in Liaoning Assisted by New Marketing" (Liaoning Provincial Social Science Planning Fund Project), conducting systematic research on farmers' professional cooperatives in

the province and sorting out development models and existing problems; second, completing the "Research on Industry Education Integration Model Oriented Towards New Media Marketing of Agricultural Products" (Liaoning Provincial Department of Education Project), exploring the use of new media and new marketing to promote agricultural product sales through teaching method and curriculum content reform. These preliminary achievements provided solid theoretical and practical support for the empirical research in Tieling County.

4.2 Curriculum System Reconstruction

Based on the three-level indicator system of the Five-Dimensional Identification framework, the research team carried out modular reconstruction of the entrepreneurship education curriculum system, forming a three-layer progressive curriculum structure of "Basic Cognition - Specialized Training - Comprehensive Innovation."

The Basic Cognition Layer corresponds to the "Rural Entrepreneurship Mindset Identification" and "Opportunity Identification" dimensions, offered to all students, aiming to address students' understanding of rural values and opportunity discovery capabilities. Main curriculum modules include: "Rural Revitalization Policy Interpretation," "Rural Value and Cultural Identification," "Rural Resource Discovery and Assessment," and "Agricultural Product Innovation and Brand Planning."

The Specialized Training Layer corresponds to the "Environment Identification" and "Resource Identification" dimensions, offered to students with entrepreneurial intentions, aiming to develop rural environment awareness and resource integration capabilities. Main curriculum modules include: "Rural Policy Environment Analysis," "Rural Social Relations and Communication," "Rural Entrepreneurship Institutional Risk Prediction," "Rural Entrepreneurship Resource Integration," "Social Relationship Network Mobilization," "Agricultural Product E-commerce Operation," and "Rural Financial Management."

The Comprehensive Innovation Layer corresponds to the "Behavior Identification" dimension, offered to maker groups with real projects as carriers, aiming to develop students' entrepreneurial action experience and practical capabilities. Main curriculum modules include: "Return-to-Hometown Entrepreneurship Project Planning," "Cooperative Establishment and Operation," "Agricultural Product Deep Processing Technology," and "Online Marketing Practice."

4.3 Practical Platform Construction

Entrepreneurial capabilities can only be cultivated in real or highly simulated situations. The research team tried to teach beyond the campus "wall," extended the classroom to the rural fields of Tieling County, and constructed multilevel practical platforms.

Construction of Rural Practice Bases. Cooperating with the Tieling County government and enterprises, the team established industry-education integration training bases at the "Tiandiaoya" Sweet Potato Planting Base in Muchang Village and rural revitalization talent cultivation practice bases at the strawberry and mushroom planting bases

of farmers' cooperatives in Yinzhou District. From 2021 to present, more than 380 students have been organized to practice at the bases.

Rural Classroom Teaching Reform. Combining classroom teaching with actual rural industrial development, the team carried out rural classroom teaching reform. During sweet potato planting seasons, students were led to fields to learn planting techniques; during harvest seasons, students were organized to participate in harvesting and sales; during agricultural offseasons, students were led to help farmers carry out online marketing. Through "learning by doing, doing while learning, learning while doing, doing while learning," work-study integration was achieved.

Introduction of Real Project Driving. Relying on the sweet potato industry in Tieling County, the team guided students to carry out real entrepreneurial project practice. In 2022, the research team guided a student team to establish the "Tiandiaoya Sweet Potato Professional Cooperative," developing more than 50 member households and driving planting area expansion by 35 hectares. In 2023, students were further guided to extend the industrial chain, creating a sweet potato deep processing project, developing sweet potato dried products and sweet potato starch, with annual processing of 250 tons of sweet potato dried products and output value reaching 15 million yuan.

Stimulation of Entrepreneurial Enthusiasm. In autumn 2022, the research team, in conjunction with local government, created the first "Tieling County Sweet Potato Festival," organizing students to carry out live streaming sales, agricultural product displays, brand promotion, and other activities. It has been held for three consecutive years to date, with cumulative participation of more than 200 students.

4.4 Ecosystem Construction

Entrepreneurship education is a systematic project requiring collaborative participation from multiple subjects such as government, schools, enterprises, and rural areas. In the Tieling County practice, the research team constructed a multi-subject collaborative education entrepreneurship education ecosystem.

School-Local Collaborative Education Mechanism. Establishing strategic cooperative relations with the Tieling County government to jointly promote rural revitalization talent cultivation. The county government provides guarantees in policy support, base construction, and project docking, while the school provides services in talent cultivation, technical guidance, and intellectual support.

Four-Party Linkage of Government, School, Enterprise, and Village. Inviting local government departments, agricultural enterprises, and village collective organizations to jointly participate in talent cultivation. From 2021 to present, more than 60 experts from government, enterprise, and village sectors have been invited to participate in teaching activities.

New Farmer Mentor Team Construction. Hiring locally successful "new farmers" as parttime mentors, using the "master-apprentice" method to guide students in entrepreneurial practice. The current mentor team has 12 people, covering multiple fields such as planting, processing, and marketing.

Entrepreneurship Incubation Support System. Establishing a three-level incubation system of "Entrepreneurship Nursery plus Incubator plus Accelerator." An entrepreneurship nursery was established on campus, providing office space and basic services for 8 student entrepreneurial teams; an entrepreneurship incubation base was established in Tieling County, providing space support and policy docking for 3 mature projects.

5 Evaluation of the Framework

Based on the three-level indicator system of the Five-Dimensional Identification framework, the research team designed a comprehensive evaluation protocol and collected data from 86 participating students (including 32 who completed the full three-year cultivation cycle) between 2021 and 2024. Evaluation instruments included Entrepreneurial Capability Self-Assessment Questionnaire (45 items, 5-point Likert scale), teacher observation records, project outcome tracking, and graduate follow-up surveys. Two primary methods were applied: classical test theory for instrument validation and descriptive/inferential statistics for effect measurement, complemented by a machine learning approach to identify key drivers of capability improvement.

5.1 Evaluation of Students' Entrepreneurial Capability Improvement

Evaluation data indicate that students' overall mean of Five-Dimensional Identification capabilities increased from 2.48 to 4.00, an improvement of 1.52 points (95% CI [1.31, 1.73]), with statistically significant differences ($t(31) = 14.36$, $p < 0.001$, Cohen's $d = 3.01$, 95% CI [2.34, 3.68]). All dimensions showed improvement (table 2), with the Behavior Identification dimension showing the largest improvement (+1.65, 95% CI [1.39, 1.91]), followed by Environment Identification and Resource Identification dimensions (+1.58 each).

Table 2. Comparison of students' five-dimensional identification capabilities pre- and post-test (n=32).

Capability Dimension	Di-Pre-Test (M±SD)	Mean Post-Test (M±SD)	Mean Difference	t-value	p-value
Rural Entrepreneurship Mindset Identification	2.84±0.62	4.12±0.43	+1.28	9.84	<0.001
Opportunity Identification	2.56±0.71	4.05±0.51	+1.49	11.23	<0.001
Environment Identification	2.31±0.68	3.89±0.58	+1.58	12.06	<0.001
Resource Identification	2.43±0.73	4.01±0.47	+1.58	11.87	<0.001
Behavior Identification	2.27±0.69	3.92±0.54	+1.65	13.12	<0.001
Overall	2.48±0.58	4.00±0.42	+1.52	14.36	<0.001

5.2 Machine Learning Analysis of Capability Drivers

To uncover hidden patterns and identify the most influential factors driving improvement, a random forest regression model was implemented using Python (scikit-learn). This method was chosen for its ability to handle non-linear relationships and provide interpretable feature importance rankings.

Feature Set. The model was trained to predict the post-test overall score using 11 input features: pre-test scores for each of the five dimensions, demographic variables (gender, age, family rural background), and participation intensity metrics (number of practice base visits, hours of live streaming participation, number of mentor sessions). The dataset comprised the 32 students with complete records.

Model Performance. The random forest (500 trees, max depth = 5) explained 78.3% of the variance in the post-test scores ($R^2 = 0.783$) after 10-fold cross-validation, suggesting strong predictive power within this sample. However, due to the small sample size ($N=32$), the feature importance analysis is exploratory and prone to overfitting; findings should be interpreted with caution.

To assess stability, we performed bootstrap resampling with 100 iterations to estimate 95% confidence intervals for feature importance scores. The intervals were: Behavior: [0.18, 0.29]; Resource: [0.14, 0.24]; Practice visits: [0.11, 0.21]; Live hours: [0.08, 0.19]; Environment: [0.07, 0.17]. These intervals indicate moderate stability but also highlight uncertainty due to sample size limitations.

Feature Importance. Figure 1 displays the feature importance scores (mean decrease in impurity). The top five predictors were:

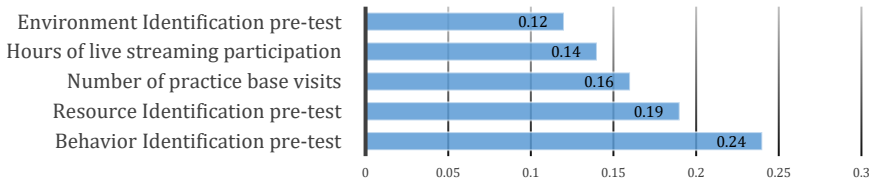


Fig. 1. Importance from random forest model

These results highlight that students' initial levels of behavior and resource capabilities, combined with intensive practical activities (field visits and digital marketing practice), are the strongest drivers of overall entrepreneurial development. Notably, digital engagement (live streaming) emerged as a significant predictor, underscoring the importance of integrating technology into rural entrepreneurship education.

5.3 Evaluation of Student Entrepreneurship Project Incubation Outcomes

The research team conducted tracking evaluation of entrepreneurship projects of participating students, with an evaluation cycle from 2021 to 2024 (table 3).

Table 3. Statistics of student entrepreneurship project incubation outcomes.

Indicator	Quantity
Number of student entrepreneurship project proposals completed	28
Number of projects entering campus entrepreneurship nursery	8
Number of projects entering Tieling County entrepreneurship incubation base	3
Number of registered farmers' professional cooperatives	2
Number of registered enterprises	1
Number of jobs created	26
Project annual output value (2024)	16.2 million yuan

Main achievements include: the "Tiandiaoya Sweet Potato Professional Cooperative" established by the student entrepreneurial team has developed more member households, driven planting area expansion to higher, and increased household income by 10% per year on average; the sweet potato deep processing capacity increases by 20%, and products are sold nationwide through e-commerce platforms. This project won the silver award in the provincial innovation and entrepreneurship competition; the e-commerce account operated by the student team has exceeded 50,000 followers, with annual live streaming sales exceeding 1.2 million yuan.

5.4 Tracking Evaluation of Graduates' Return-to-Hometown Entrepreneurship

The research team conducted tracking surveys of 54 graduates from 2022 to 2024 to understand their employment and entrepreneurship situations (table 4).

Table 4. Tracking records of graduates' return-to-hometown entrepreneurship.

Graduation Year	Graduates	Return-to-Hometown Employment	Return-to-Hometown Employment Rate	Return-to-Hometown Ent.	Return-to-Hometown Ent. Rate	Project Survival Rate (1 year later)
2022	18	8	44.4%	3	16.7%	100% (3/3)
2023	20	11	55.0%	5	25.0%	80% (4/5)
2024	16	9	56.3%	4	25.0%	tracking
To-tal/Avg.	54	28	51.9%	12	22.2%	87.5% (7/8)

Tracking data indicate that among 54 graduates, 28 returned to hometowns for employment (51.9%), and 12 returned to hometowns for entrepreneurship (22.2%), compared to the return-to-hometown entrepreneurship rate of non-project students at the same school (approximately 8%, based on institutional graduate surveys). Entrepreneurship projects involve multiple fields such as sweet potato planting and processing, agricultural product e-commerce, and leisure agriculture, with a project survival rate of 87.5% after one year.

5.5 Evaluation Feedbacks

The research team collected evaluation feedback from multiple subjects including students, teachers, mentors, and cooperative enterprises.

Student Self-Assessment Feedback: In open-ended questionnaires, students generally reported that the Five-Dimensional Identification framework made their entrepreneurial goals clearer. A 2024 graduate feedback: "I used to think entrepreneurship was just starting a company. Through the study of the Five-Dimensional Identification framework, I understood the particularity of rural entrepreneurship, learned how to discover the value of local resources, and how to deal with villagers—things that cannot be learned in the classroom."

Teacher Observation Evaluation: The professional teacher team gave positive evaluations of students' capability development through classroom observation and practical guidance. Data shows that the correlation coefficient between teacher evaluation and student self-assessment is 0.76, indicating good consistency in evaluation.

Enterprise Mentor Feedback: New farmer mentors participating in the project generally reported that students' practical capabilities have significantly improved. Feedback from the cooperative director mentor: "These students learn quickly, understand technology, can market, and can get along with our farmers. They are the talents we urgently need."

Cooperative Partner Evaluation: The Tieling County Agriculture and Rural Affairs Bureau evaluated in the project summary that students cultivated through this model "can go down, stay, and be useful," providing important talent support for the county's sweet potato industry development.

6 Conclusion and Discussion

This study introduced the Five-Dimensional Identification framework and its three-level indicator system as a theoretically grounded approach to assessing and guiding rural entrepreneurship education in higher vocational colleges. The framework was implemented in a three-year educational program involving 86 students in Tieling County, Liaoning Province. Using a one-group pre-test/post-test design, we observed improvements across all five dimensions of entrepreneurial capability, with effect sizes ranging from $d = 2.41$ to 3.01 . An exploratory random forest analysis suggested that pre-test behavior and resource identification scores, along with practice base visits and live streaming participation, were associated with post-test outcomes, though due to the small sample size ($N=32$), these findings are exploratory and require replication with larger samples.

Methodological Limitations: Several important limitations must be acknowledged. First, the one-group pre-test/post-test design lacks a control group, preventing causal attribution of observed changes to the intervention. Alternative explanations—including maturation (natural developmental changes over time), history (external events such as policy changes), testing effects (sensitization from repeated measurement), and regression to the mean—cannot be ruled out. Second, the small sample size ($n=32$ for the primary analysis) limits statistical power and increases the risk of overfitting in the

machine learning analysis. Third, selection bias may be present, as participants self-selected into the program and may differ systematically from non-participants. Fourth, self-reported capabilities may be subject to social desirability bias, though the Harman test suggested this was not a major concern. Fifth, the study was conducted in a single county in Liaoning Province; results may not generalize to other regions or educational contexts.

Theoretical and Practical Contributions: Despite these limitations, the study contributes: (1) a validated measurement framework for rural entrepreneurial capability with 45 specific behavioral indicators; (2) preliminary evidence of the framework's utility in curriculum design and program evaluation; and (3) exploratory data-driven hypotheses about key factors associated with capability improvement that can be tested in future research.

Future Research Directions: Future research should employ randomized controlled trials or quasi-experimental designs with comparison groups to establish causal effects. Replication with larger, more diverse samples is needed to validate the framework and the machine learning findings. Development of objective performance measures to supplement self-reported capabilities would strengthen future evaluations. Finally, longitudinal designs examining the sustainability of capability gains beyond the program period would provide valuable insights.

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