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Article

From labor-market skill demand to entrepreneurship readiness: A preliminary sustainable entrepreneurship education framework for higher vocational education in Yunnan province

Lu Guo, Panjanat Vorawattanachai

Institute of Science, Innovation and Culture, Rajamangala University of Technology Krungthep, Bangkok 10120, Thailand
*** Corresponding author:** Panjanat Vorawattanachai, panjanat.v@mail.rmutk.ac.th

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Abstract: Background: Higher vocational education (HVE) in China is expected to convert technical training into durable graduate employability, and provincial systems such as Yunnan's must achieve this within smaller, less diversified regional economies. Sustainable entrepreneurship education is increasingly proposed as a route to stronger career agency, yet curriculum design in this setting is rarely anchored in observed labor-market behavior. **Aim:** Because publicly available, Yunnan-specific data linking entrepreneurship training to employability outcomes remain scarce, this study develops a preliminary, evidence-informed training framework rather than testing an intervention. **Data and method:** The empirical foundation is the Job-SDF benchmark, a multi-granularity record of monthly job-skill demand compiled from millions of Chinese online job advertisements over 2021–2023 (2335 skills; 14 occupation groups; 7 regional markets). Using a transparent secondary-analysis pipeline, aggregate, occupational, regional, concentration, structural-break and skill co-occurrence patterns were summarized and translated into curriculum components; one mid-sized regional market (Region 6) is treated as an illustrative mid-sized regional case, broadly comparable to a developing provincial economy such as Yunnan's, rather than as a direct proxy for the province. **Findings:** Demand grew at a compound annual rate of 10.1 % with a recurring mid-year peak; it is highly concentrated (Gini = 0.85; the top 10% of skills absorb 76.3 % of demand); the illustrative regional case holds only 7.1 % of national demand; 64.7 % of aggregate skill series exhibit structural breaks; and high-demand skills resolve into five co-occurrence clusters. **Contribution:** These patterns are mapped onto a five-phase sustainable entrepreneurship training framework with a continuous-improvement loop. **Limitations and future work:** The dataset is not Yunnan-specific and its entities are anonymized; the framework is therefore preliminary and requires validation with primary, named data and a controlled pre–post design in Yunnan HVE institutions.

Keywords: sustainable entrepreneurship education; higher vocational education; employability; entrepreneurship readiness; labor-market skill demand; industry–education integration; curriculum framework; Yunnan

1. Introduction

Higher vocational education (HVE) plays a crucial role in China's agenda for quality employment and regional development, with policy reforms increasingly emphasizing service to local economic needs and stronger school–enterprise cooperation [1,2]. Rather than measuring success through enrolment numbers, attention has turned to the outcomes of graduate employment and adaptability in shifting labor markets. Entrepreneurship education has been developed across Chinese higher institutions as one response to this challenge, with its effectiveness shaped by

curriculum design, teaching teams, practical platforms and institutional support [3–5]. In this way, adding the additional dimension of sustainability to that agenda means looking at ventures and competencies that generate value in environmentally and socially sustainable ways [6–8].

The case of Yunnan exemplifies this potential as well as the challenge. As a south-western, culturally diverse, and predominantly rural province, its competitive advantages are clearly tourism, agriculture, agribusiness, cultural industries, and increasingly, cross-border trade and rural e-commerce in neighboring economies. For HVE graduates, this would be a setting conducive to entrepreneurial ventures with promising absorptive capacity [9,10]. However, evidence from Chinese vocational education indicates that students' perceived employability is shaped by institutional quality and university–industry collaboration [11]. An approach that is genuinely attuned to labor market needs requires evidence-based knowledge of these needs, rather than importing knowledge that applies to other regions.

While there are two streams of research that touch upon this need, these seldom intersect. The first focuses on entrepreneurial intentions and their determinants – attitudes, subjective norms, behavioral control, self-efficacy, and opportunity recognition – mostly through questionnaire surveys conducted on university students [12–15]. The second relies on big data in labor markets, particularly skill requirements advertised by recruiters in online job announcements, to identify evolving employer demands [16,17]. While industry-education integration is a stated policy objective for vocational curriculum design, this is heavily influenced by the former body of research over the latter [2,18].

A practical result of this mismatch is a clear gap. There is a lack of evidence based on Yunnan-specific vocational student surveys that examines the effect of entrepreneurship training on graduate employability. Moreover, there is limited effort to develop an entrepreneurship education framework based on observed skill demands. This paper fills this gap in a conservative way. Instead of attempting new primary empirical findings, existing secondary evidence, primarily the Job-SDF job-skill-demand benchmark [16], is taken as the empirical basis for such a framework. The objectives are to (i) summarize the patterns and trends of skill demands relevant to vocational entrepreneurship education; (ii) apply them, via mapping, to produce a sustainable vocational entrepreneurship training framework for Yunnan; and (iii) outline how this framework is validated using Yunnan-specific primary evidence. Employability is considered only as the distal output indicator: Instead, skill demands are seen as an intermediate indicator that leads to entrepreneurship readiness.

2. Literature review

2.1. Sustainable entrepreneurship education

Sustainable entrepreneurship education extends conventional enterprise teaching by asking students to pursue opportunities that are economically viable and, at the same time, environmentally and socially responsible [6,8]. Bibliometric and systematic-review work shows a field that has grown quickly but unevenly, with recurring calls to move from general awareness-raising towards competence-oriented teaching and assessment [7,19]. A useful anchor is the body of work on key

competencies in sustainability, which converges on systems, futures, values, strategic and interpersonal thinking, complemented by implementation and integration competencies [8]; embedding the Sustainable Development Goals into program design has been shown to be feasible but demanding for institutions [20]. Case evidence from Chinese universities indicates that sustainability-oriented entrepreneurship can be integrated into the curriculum, though largely in elite, research-intensive settings rather than vocational ones [21]. For HVE the implication is that sustainability should be operationalized as concrete, teachable competencies tied to local value creation, not treated as a rhetorical overlay.

2.2. Employability and entrepreneurship readiness in vocational education

Employability is best understood not as a fixed stock of skills but as the capacity and enabling conditions for sustained labor-market participation, shaped by personal attributes, learning and context. Work-integrated learning — placements, internships and authentic project work — is among the most consistently supported levers for it, with large-scale evidence that different forms of work-integrated learning improve both perceived employability and skill outcomes [22,23]. Within this literature, entrepreneurship is increasingly positioned as part of employability rather than an alternative to it: Enterprise education cultivates an entrepreneurial orientation and achievement motivation that feed graduate readiness even for those who never found a firm [5,24]. For vocational students specifically, employability and entrepreneurship readiness are associated with university–industry exposure, practice-oriented learning and educational support linked to entrepreneurial self-efficacy [11,25]. This study adopts that integrative view and uses *entrepreneurship readiness* and *career agency* — rather than employment itself — as the proximal outcomes a training framework can reasonably target.

2.3. The theory of planned behavior and entrepreneurial intention

Entrepreneurial intention remains the dominant construct in this literature, and it rests on Ajzen's theory of planned behavior (TPB) [13,14], in which attitude toward the behavior, subjective norms, and perceived behavioral control jointly shape the intention that precedes entrepreneurial action. Attitude and perceived behavioral control are consistently found to be the strongest predictors of entrepreneurial intention; subjective norms are a weaker and less consistent predictor, and many studies therefore add self-efficacy, need for achievement, or relational support [24,26–29]. These findings are corroborated by evidence from Chinese college students, which indicates that entrepreneurship education exerts an effect through inspiration, mindset, and competence [5,29–33]. Although TPB is primarily a predictive model rather than a design tool, it also supplies a useful design vocabulary here, since it identifies the psychological levers — attitudes, norms, and perceived control — that an entrepreneurship-readiness curriculum can deliberately seek to shape.

2.4. Opportunity recognition and sustainability values

Opportunity-driven entrepreneurship is generally more durable than necessity-driven entrepreneurship, and the ability to identify and evaluate opportunities is a competence that education can develop [15,34]. Studies of Chinese students link entrepreneurial opportunity identification to intention, mediated by psychological capital, and treat opportunity recognition as a teachable, practice-based skill rather than an innate trait [15]. In parallel, sustainability values and pro-environmental norms have been shown to raise social and sustainable entrepreneurial intention, including among Chinese university students [12,35]. Read together, this work suggests that an effective framework should pair structured opportunity-recognition activity — scanning real local problems and unmet needs — with explicit cultivation of sustainability values, so that the opportunities students pursue are both viable and responsible.

2.5. Industry–education integration in Chinese higher vocational education

Industry–education integration is the organizing principle of contemporary Chinese vocational reform, expressed through enterprise participation in curricula, dual-teacher arrangements and shared training facilities [2,18,36]. Policy reviews and integration studies stress that the gains depend on the depth of enterprise involvement and on alignment between programme content and real occupational demand, rather than on partnership in name only [2,37]. Entrepreneurship education has become an important strand of Chinese higher vocational reform, and evidence indicates that perceived educational and policy support is positively associated with vocational students' entrepreneurial self-efficacy and intention [25]. A recurring weakness, however, is that curricula are too often specified from supply-side assumptions; labor-market-intelligence approaches that mine job advertisements offer a replicable way to calibrate provision against actual demand and its volatility [17]. This study operationalizes industry–education integration in exactly that demand-calibrated sense.

2.6. Research gap and contribution

Across these strands, intention research rarely connects to observed skill demand; skill-demand analytics rarely informs entrepreneurship curricula; and almost none of this work is specific to Yunnan HVE. The systematic-review literature on entrepreneurship education likewise notes a persistent gap between frameworks and locally validated, outcome-oriented designs [38]. The contribution of this paper is to bridge intention-based and demand-based perspectives by translating a large, authentic skill-demand benchmark into an operational, sustainability-oriented entrepreneurship-training framework for Yunnan HVE — explicitly preliminary, and explicitly designed for subsequent primary validation.

3. Materials and methods

3.1. Theoretical framework

The framework integrates five perspectives. From the Theory of Planned Behavior, it takes the proximal drivers of entrepreneurial intention — attitude, subjective norms and perceived behavioral control — as competencies a curriculum can shape [13,14]. From sustainable entrepreneurship theory it takes the requirement that opportunities create economic, environmental and social value simultaneously, expressed through teachable sustainability competencies [6,8]. From opportunity-recognition theory it takes the view that identifying and evaluating opportunities is a developable competence best learned on real problems [15,34]. From human-capital and employability theory it takes the principle that targeted, practice-rich learning builds the capabilities and enabling conditions for labor-market participation [22,23]. From the industry–education integration tradition it takes enterprise co-design and work-integrated practice as delivery mechanisms [2,18].

These perspectives are linked by a single logic, shown in **Figure 1**. Observed labor-market skill demand and sustainable-education principles jointly inform the design of an entrepreneurship-training program; the program cultivates the TPB drivers and the sustainability and opportunity-recognition competencies; these produce entrepreneurship readiness and career agency as proximal outcomes; and graduate employability sits further downstream as a distal outcome that the present evidence can inform but not demonstrate. A feedback loop returns graduate and employer outcomes to program design, embodying the sustainability principle that a curriculum must be renewed as the market shifts.

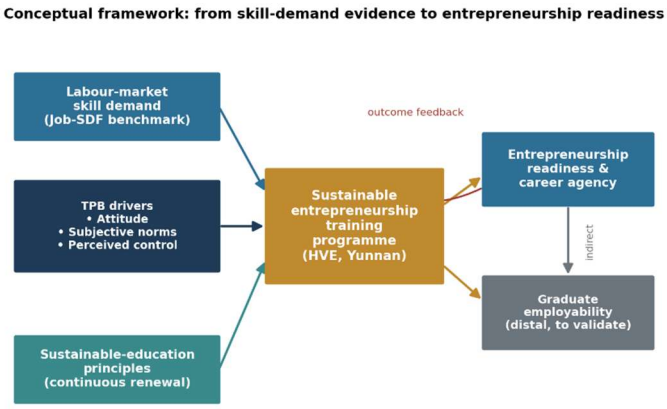

Figure 1. Conceptual framework linking labor-market skill demand and sustainable-education principles, through Theory-of-Planned-Behavior drivers, to entrepreneurship readiness and the distal outcome of graduate employability.

3.2. Design

This is a secondary evidence-informed framework-development study. No new primary data were collected and no new statistical estimation was performed: The numerical results reported in Section 4 are extracted from, or computed directly on, a published benchmark dataset and its accompanying analysis. The study's product is a

framework and a validation plan, not a hypothesis test. This design is appropriate where, as here, a strong public dataset exists but province-specific primary data do not, and where the goal is to make subsequent primary research more focused and economical.

3.3. Data source

The empirical foundation is the Job-SDF benchmark [16], a multi-granularity dataset for job-skill-demand forecasting compiled from millions of public job advertisements posted on major Chinese online recruitment platforms between January 2021 and December 2023. It records monthly recruitment demand for individual skills at occupation, company and regional granularities, together with a skill co-occurrence graph and a flagged set of skills exhibiting statistical structural breaks. Entity names (skills, occupations, regions) are withheld by the dataset authors for privacy, so entities are referenced by numeric identifiers. **Table 1** summarizes the components used here.

Table 1. Composition of the Job-SDF evidence base used in this study.

Dimension	Granularity / unit	Count	Role in this study
Skills	Individual skill series	2335	Curriculum content units
L1 occupations	Broad occupation groups	14	Program tracks/specializations
L2 occupations	Detailed occupation groups	52	Module-level targeting
Regions	Regional labor markets	7	Illustrative mid-sized regional case
Time span	Consecutive months	36	Trend and seasonality analysis
Observations	Skill × month demand records	81,322,833	Statistical basis

Note. Compiled from the Job-SDF benchmark [16]. Counts are at the L1-occupation granularity.

3.4. The illustrative mid-sized regional case

Because regional names are anonymized in the public release, a transparent and deliberately cautious convention is adopted: One of the seven regional markets (Region 6) is examined as an illustrative mid-sized regional case rather than as a direct proxy for Yunnan. It is a mid-sized market — neither one of the dominant metropolitan hubs nor one of the smallest markets — and this profile is broadly comparable to that of a developing provincial economy such as Yunnan's. The regional results should therefore be read as a demonstration of the methodology on a representative mid-sized market, illustrating the kind of structural pattern a developing province might exhibit, and the identical pipeline can be re-run on genuinely Yunnan-specific data once such data become available. The case is illustrative only: Its status as a regional analogue, and not as Yunnan itself, is stated plainly here and is revisited in the limitations.

3.5. Analytical pipeline

The workflow moves from raw monthly counts to program-design decisions in six stages: Ingestion and cleaning; aggregation across the 36-month window; demand, growth and structural-break analysis; skill clustering via co-occurrence; mapping of

clusters onto curriculum modules; and specification of a program with measurable indicators. A sustainability loop returns later outcomes to the first stage, so the analysis is intended to be repeated periodically rather than run once. The pipeline is shown in **Figure 2**.

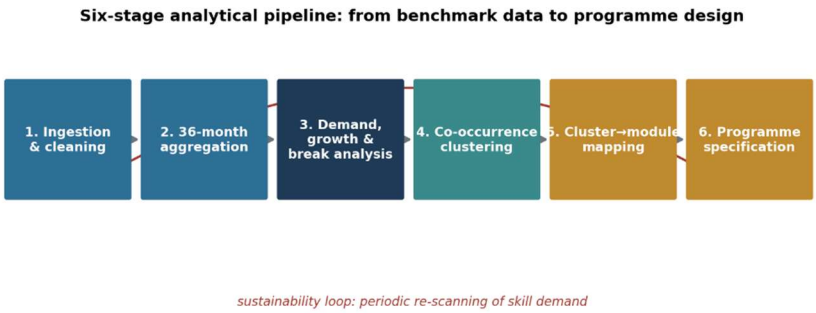

Figure 2. Six-stage analytical pipeline translating the Job-SDF benchmark into entrepreneurship-program design decisions, with a sustainability loop for periodic re-scanning.

3.5.1. Computation of the reported indicators

To support reproducibility, the summary indicators reported in Section 4 were obtained as follows. The compound annual growth rate (CAGR) was computed from the annual demand totals using the standard expression

$$CAGR = \left(\frac{V_n}{V_0}\right) \wedge \left(\frac{1}{n}\right) - 1 \tag{1}$$

where V_0 is the 2021 total (24,956,289), V_n is the 2023 total (30,254,811) and $n = 2$ is the number of one-year intervals between the first and last year; this gives

$$\left(\frac{30{,}254{,}811}{24{,}956{,}289}\right) \wedge \left(\frac{1}{2}\right) - 1 \approx 10.1\ \% \tag{2}$$

The quarterly seasonality index was obtained by averaging monthly demand within each calendar quarter across the 36-month window and expressing each quarter relative to the weakest quarter (Q1).

The concentration of skill demand was measured on the distribution of cumulative demand across the 2335 individual skill series. Skills were ranked in ascending order of cumulative demand, the Lorenz curve of the cumulative share of demand against the cumulative share of skills was constructed, and the Gini coefficient was computed from it as

$$G = 1 - \sum (X_k - X_{k-1})(Y_k + Y_{k-1}) \tag{3}$$

where X_k is the cumulative share of skills and Y_k the cumulative share of demand at rank k. The head–tail shares (top 10 % = 76.3 % and top 20 % = 88.9 % of demand) were read directly from the same ranked cumulative distribution, yielding the overall Gini value of 0.85.

Structural breaks were not re-estimated in the present study. The analysis uses the set of series that the published Job-SDF benchmark flags as exhibiting statistically

significant structural breaks — that is, abrupt shifts in the level or trend of a demand series — on the basis of the benchmark's change-point detection. For each level of granularity—aggregate, L1 occupation, L2 occupation and regional—the reported share was calculated as the number of flagged series divided by the total number of series at that granularity; thus, the figures describe how often the dataset records a break rather than offering a new estimate of one.

Finally, the skill co-occurrence clusters were derived from the skill co-occurrence graph supplied with the benchmark. Analysis was restricted to the high-demand skills, and an undirected, weighted network was constructed in which each node is a skill and an edge links two skills that are recruited together; the edge weight equals the number of the 14 L1 occupation groups in which the pair co-occurs, so weights range from 1 to a maximum of 14. Retaining the strongest links and applying community detection to group densely connected skills produced the five competency bundles reported in Section 4.7, while pairs carrying the maximum weight of 14 were interpreted as universal, cross-cutting competencies suitable for a shared entrepreneurship core.

3.6. Translating empirical constructs into framework components

To keep the inference auditable, each empirical construct drawn from the dataset is mapped explicitly to a theoretical role, a training-framework implication and a stated limitation (**Table 2**). The mapping is deliberately conservative: Demand signals justify *what* is taught and *when*, whereas the psychological drivers of intention and readiness are justified by the separate literature reviewed in Section 2, not by the demand data themselves.

Table 2. Mapping of empirical constructs to theoretical roles and training-framework implications.

Dataset construct	Meaning in the source dataset	Theoretical role	Training-framework implication	Limitation
Aggregate demand level and growth	Total monthly skill demand and its trend	Market signal of opportunity scale	Time intakes and venture milestones to demand peaks	Advertising demand ≠ realized hiring
Skill-level demand	Demand per individual skill	Human-capital content priorities	Define employability core and venture niches	Skills are anonymized identifiers
Occupational structure	Demand by occupation group	Sectoral opportunity structure	Set program tracks and specializations	Coarse 14-group resolution
Regional demand	Demand by regional market	Local opportunity context	Localize scale and content to Yunnan	Region is an illustrative analogue, not Yunnan itself
Concentration (Gini)	Inequality of demand across skills	Head–tail opportunity structure	Separate employability core from venture tail	Concentration may shift over time
Structural breaks	Abrupt shifts in demand series	Market volatility / non-stationarity	Adopt modular, renewable content	Breaks detected, not explained
Skill co-occurrence	Skills recruited together	Competency-bundle structure	Organize modules around co-required bundles	Co-occurrence ≠ causation

Note. Demand-side constructs are evidenced by the Job-SDF data [16]; intention/readiness drivers are evidenced by the literature in Section 2.

4. Summary of public dataset findings for framework development

This section reports patterns computed on the benchmark. To avoid overstatement, results are attributed to the source data throughout, and their interpretation for training design is kept separate from the figures themselves.

4.1. Aggregate demand trends

Total skill demand rose across the window, from 24,956,289 recorded demand units in 2021 to 30,254,811 in 2023 — a compound annual growth rate of 10.1 % (**Table 3**, **Figure 3**). The trend is upwards but cyclical with deep dips at the beginning of every calendar year, which correspond with the lull in hiring that typically occurs after the Spring Festival. There is a trend of seasonality: From the average figures over the 3 years, Q3 demand is about 38 % greater than Q1 demand (**Table 4**, **Figure 4**). To design the program, this makes a case for matching internship placements, graduation and milestones in the incubation process with the mid-year peak.

Table 3. Annual demand totals and growth.

Year	Total skill demand	Year-on-year change	Index (2021 = 100)
2021	24,956,289	—	100.0
2022	26,111,733	+4.6 %	104.6
2023	30,254,811	+15.9 %	121.2

Note. Computed from the Job-SDF benchmark [16].

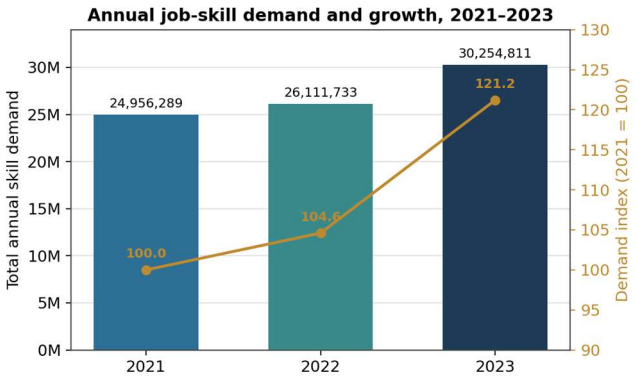

Figure 3. Annual job-skill demand (bars) and demand index (line), 2021–2023.

4.2. Skill-level analysis

The most-recruited skills represent foundational employability content, while the fastest-growing skills mark the frontier where entrepreneurial opportunity concentrates. The single most-demanded skill accumulated 2,639,882 demand units over three years, well ahead of the field, and the top ten form the backbone of recruitment demand (**Table 5**, **Figure 5**). Comparing 2023 with 2021 reveals sharp divergence: The fastest-growing skill expanded by roughly 540 %, signaling new and under-served competencies, whereas several skills contracted by more than half (**Tables 6** and **7**, **Figure 6**). A forward-looking program should teach the high-demand core for baseline employability while treating fast-growing, under-served competencies as venture territory, and should de-emphasize clearly declining content.

Table 4. Average quarterly demand index.

Quarter	Average monthly demand	Relative to weakest quarter
Q1	1,867,890	0 %
Q2	2,287,014	+22 %
Q3	2,573,946	+38 %
Q4	2,307,021	+24 %

Note. Computed from the Job-SDF benchmark [16].

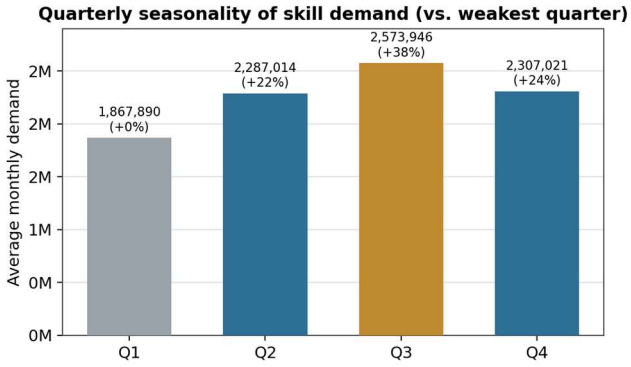

Figure 4. Quarterly seasonality of skill demand, expressed relative to the weakest quarter.

Table 5. Top 15 skills by cumulative demand, 2021–2023.

Rank	Skill ID	Cum. demand	Rank	Skill ID	Cum. demand
1	Skill 1654	2,639,882	9	Skill 1709	1,079,340
2	Skill 242	1,725,415	10	Skill 1127	1,002,878
3	Skill 82	1,672,673	11	Skill 183	993,771
4	Skill 2076	1,485,483	12	Skill 154	992,271
5	Skill 1290	1,412,313	13	Skill 1064	939,274
6	Skill 2155	1,300,570	14	Skill 1701	745,830
7	Skill 2207	1,142,472	15	Skill 2248	680,296
8	Skill 534	1,086,824			

Note. Computed from the Job-SDF benchmark [16]. Skill 1654 represents 3.25 % of total demand.

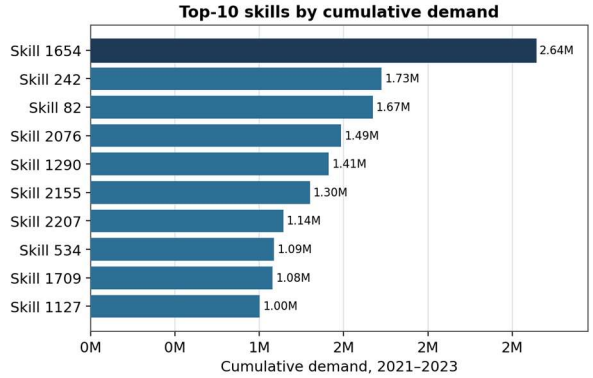

Figure 5. Top-10 skills by three-year cumulative demand.

Table 6. Emerging skills — curriculum priorities.

Skill ID	2021 demand	2023 demand	Growth
Skill 2314	2655	16,980	+540%
Skill 1021	5211	21,550	+314%
Skill 706	3675	14,990	+308%
Skill 1584	3843	15,198	+295%
Skill 174	5236	18,792	+259%
Skill 2316	7681	27,380	+256%

Note. Computed from the Job-SDF benchmark [16].

Table 7. Declining skills-candidates for phase out.

Skill ID	2021 demand	2023 demand	Change
Skill 568	9053	4329	−52%
Skill 1516	3354	1539	−54%
Skill 887	8895	3813	−57%
Skill 2235	3698	1497	−60%
Skill 571	16,122	6223	−61%
Skill 281	28,131	10,357	−63%

Note. Computed from the Job-SDF benchmark [16].

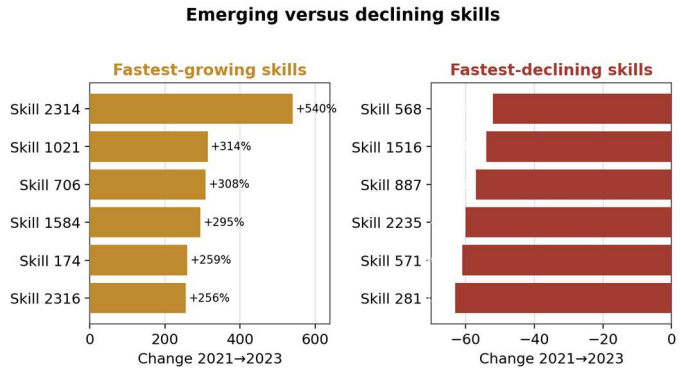

Figure 6. Fastest-growing versus fastest-declining skills, 2021→2023.

4.3. Occupational structure

Demand is unevenly distributed across the 14 broad occupation groups. The leading group alone accounts for 28.2 % of all recorded demand, and the top three groups dominate the market (**Table 8**, **Figure 7**). This concentration indicates which program tracks would place the most graduates, while the smaller groups identify specialized niches better suited to entrepreneurship and self-employment pathways.

Table 8. Demand by L1 occupation group (top 10 of 14).

Rank	Occupation ID	Cumulative demand	Share	Rank cont.
1	Occupation 7	22,911,584	28.2 %	—
2	Occupation 11	10,728,554	13.2 %	—
3	Occupation 9	9,584,965	11.8 %	—
4	Occupation 1	7,997,187	9.8 %	—
5	Occupation 6	7,317,139	9.0 %	—

Table 8. (*Continued*).

Rank	Occupation ID	Cumulative demand	Share	Rank cont.
6	Occupation 13	6,493,819	8.0 %	—
7	Occupation 0	4,138,351	5.1 %	—
8	Occupation 5	3,611,836	4.4 %	—
9	Occupation 10	2,983,055	3.7 %	—
10	Occupation 12	2,571,466	3.2 %	—

Note. Computed from the Job-SDF benchmark [16].

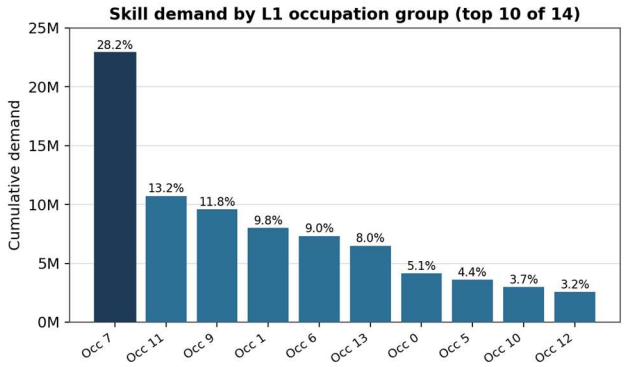

Figure 7. Skill demand by L1 occupation group; labels show share of total demand.

4.4. Regional analysis — the illustrative mid-sized regional case

Regional disparity is stark. The largest regional market records 30,487,179 demand units — about 5.3 times the volume of the illustrative mid-sized regional case (Region 6), which holds 5,734,391 units, or 7.1 % of national demand (**Table 9**, **Figure 8**). This pattern is strategically instructive for a developing province such as Yunnan: A smaller, developing market of this kind cannot simply imitate the skill mix of the metropolitan hubs. For such an economy, an entrepreneurship-led strategy that builds locally rooted ventures is therefore not merely desirable but structurally appropriate.

Table 9. Regional demand distribution.

Rank	Region ID	Cumulative demand	Share	Note
1	Region 1	30,487,179	37.5 %	
2	Region 4	17,780,896	21.9 %	
3	Region 3	17,424,809	21.4 %	
4	Region 2	6,186,171	7.6 %	
5	Region 6	5,734,391	7.1 %	Illustrative regional case
6	Region 5	2,438,572	3.0 %	
7	Region 0	1,270,815	1.6 %	

Note. Computed from the Job-SDF benchmark [16].

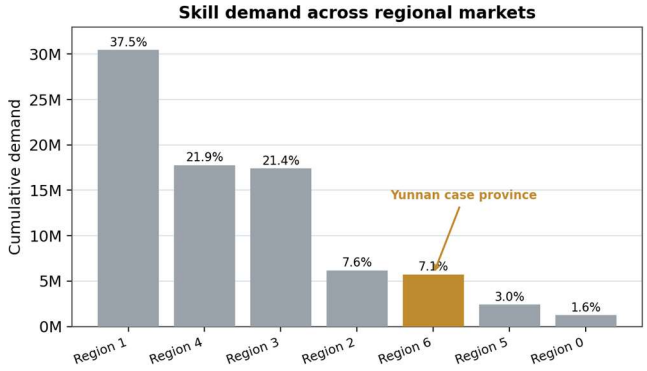

Figure 8. Total skill demand across the seven regional markets; the highlighted bar is the illustrative mid-sized regional case (Region 6).

4.5. Concentration and the long tail

There is a high degree of skill concentration. Gini coefficient results indicate that the top 10 % of skills received 76.3 % of the total demand and the top 20 % of skills received 88.9 % of the total demand (**Figure 9**). The remainder, the long tail is tiny in size, but large in count and very varied. The concentrated head is what is most needed for employability, while the long tail of the curve is an opportunity space for small ventures and self-employed graduates to stand out and stand apart from the saturated mainstream of skills.

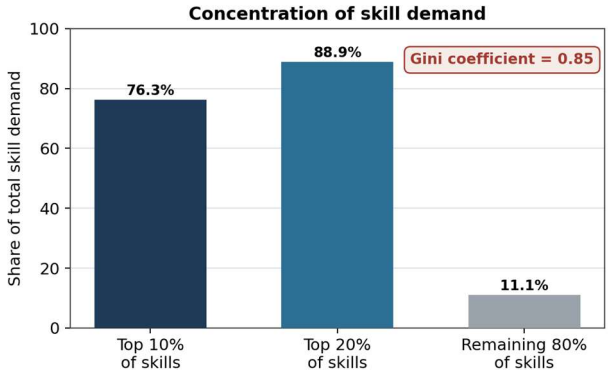

Figure 9. Concentration of skill demand: Share of total demand captured by the top 10 % and top 20 % of skills, with the overall Gini coefficient.

4.6. Structural breaks

A large share of skill series experiences structural breaks — abrupt, statistically significant shifts in demand level or trend. At the aggregate level 64.7 % of series show such a break, and 38.6 % do so even at the regional level (**Table 10**, **Figure 10**). In plain terms the market does not change smoothly; it lurches. A curriculum fixed at the point of accreditation will therefore drift out of alignment within a few years, which is the empirical case for building renewal mechanisms — periodic re-scanning, modular content and micro-credentials — directly into the program.

Table 10. Structural breaks by granularity.

Granularity	Series with a break	Share of series	Interpretation
Aggregate	1510	64.7 %	Whole-market volatility
L1 occupation	7432	22.7 %	Track-level shifts
L2 occupation	13,318	11.0 %	Module-level shifts
Regional	6317	38.6 %	Local-market shocks

Note. Computed from the Job-SDF benchmark [16].

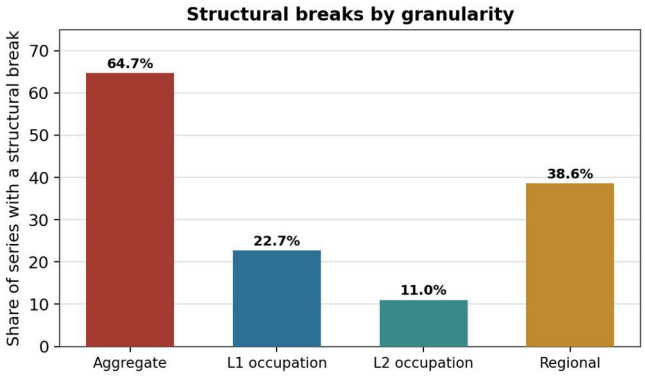

Figure 10. Share of skill–entity series exhibiting structural breaks, by granularity.

4.7. Competency bundles from co-occurrence

Skills are recruited in recurring combinations. Building a network from the strongest co-occurrence links among high-demand skills yields five distinct clusters, each a naturally co-required competency bundle and therefore a candidate curriculum module. The strongest links recur across all 14 occupation groups (co-occurrence weight 14), marking them as transferable, cross-cutting competencies suitable for a shared entrepreneurship core (**Table 11**, **Figure 11**). Teaching skills in the combinations the market actually wants is likely to support employability more than teaching the same skills in isolation.

Table 11. Strongest skill co-occurrence pairs (universal competencies).

Skill A	Skill B	Co-occurrence weight	Reading
Skill 68	Skill 1917	14	Required together in all groups
Skill 302	Skill 571	14	Required together in all groups
Skill 244	Skill 762	14	Required together in all groups
Skill 24	Skill 762	14	Required together in all groups
Skill 244	Skill 670	14	Required together in all groups
Skill 670	Skill 762	14	Required together in all groups
Skill 244	Skill 1917	14	Required together in all groups
Skill 1028	Skill 2310	14	Required together in all groups

Note. Computed from the Job-SDF benchmark [16]. A weight of 14 means the pair co-occurs across all 14 occupation groups.

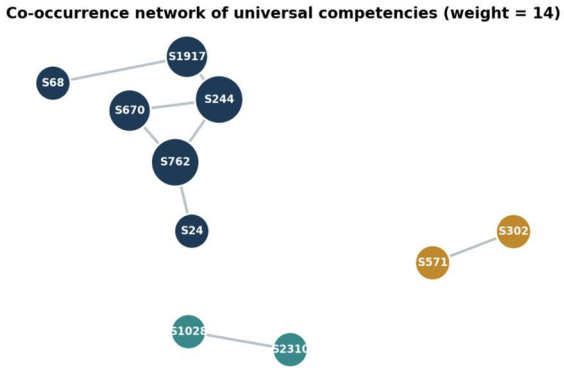

Figure 11. Co-occurrence network of universal competencies; node color denotes competency cluster and node size denotes connectivity.

5. Discussion

The synthesis supports the framework without licensing causal claims. The demand evidence is associational and reflects advertising behavior rather than realized hiring, so it justifies what a program should teach and when, but not that any particular module raises employment. Read with that caution, the patterns are coherent and mutually reinforcing. Concentration (Section 4.5) explains why a program should hold a stable employability core while reserving entrepreneurship for the diverse tail; volatility (Section 4.6) explains why that core must be modular and renewable rather than fixed; seasonality (Section 4.1) explains why work-integrated learning and venture milestones should be timed to the mid-year peak; and co-occurrence (Section 4.7) explains why modules should be built around bundles of skills that are recruited together. This interpretive caution aligns with the wider labor-market-intelligence literature, which treats online job-advertisement data as a timely but indirect signal of employer demand rather than as a record of completed hiring [39].

The intention literature explains why the psychological components matter. Attitude and perceived behavioral control are the most consistent predictors of entrepreneurial intention, which is why Phases 1 and 2 target them directly [13,14,28]. Subjective norms are weaker and more context-dependent, but in a tightly networked provincial setting peer and family expectations still shape whether students act, so enterprise mentoring and visible local role models in Phase 4 are designed partly to shift those norms [12,29]. Opportunity recognition and sustainability values are treated as developable competencies rather than traits, consistent with evidence that opportunity-driven, responsibly framed entrepreneurship is both more durable and more teachable [8,15,34]. Recent evidence reinforces this design logic: Entrepreneurship education appears to shape sustainable entrepreneurial intention largely through students' attitudes [40], yet institutional support converts that intention into entrepreneurial behavior only when it is paired with hands-on practice [41] — precisely the role assigned to the enterprise mentoring and work-integrated learning of Phase 4. For Yunnan HVE specifically, the framework offers a way to design entrepreneurship-readiness provision that is calibrated to local demand and renewable as that demand shifts — while making clear that the design is a hypothesis about the province, to be confirmed with local data. Recent Chinese evidence that

entrepreneurship education raises graduate employability chiefly through the quality of provision, rather than through its mere presence, further supports the framework's emphasis on authentic, practice-rich delivery [42].

5.1. Proposed sustainable entrepreneurship training framework

The evidence translates into a five-phase, continuously improving program (**Figure 12**). Each phase is anchored in a specific analytical result and in the design vocabulary of Section 3, and the program's sustainability rests on a feedback loop that returns graduate and employer outcomes to the needs-diagnosis stage. **Table 12** records the explicit link from finding to design decision; **Table 13** makes the five phases operational with indicative credit h, teaching activities, assessment methods, teacher and enterprise-partner roles, and worked examples for Yunnan-relevant majors.

Figure 12. Proposed five-phase sustainable entrepreneurship training model with a continuous-improvement loop.

Table 12. Mapping analytical findings to program-design decisions.

Analytical finding	Evidence	Program-design response
Demand is rising but cyclical	CAGR 10.1 %; Q3 peak	Time intakes, internships and incubation to the mid-year demand peak
Demand is highly concentrated	Gini 0.85; top 10 % = 76.3 %	Teach the high-demand head as the employability core
A long tail of niche skills exists	Top 20 % = 88.9 % of demand	Use the tail as the venture-opportunity space for entrepreneurship projects
The illustrative mid-sized regional case represents a smaller developing-market pattern	7.1 % of national demand	Prioritize locally rooted, self-employment-oriented ventures over hub imitation
Markets break structurally	64.7 % of series break	Adopt modular content, micro-credentials and periodic re-scanning
Skills cluster into bundles	Five clusters identified	Organize modules around co-required competency bundles

Note. Findings are drawn from Section 4 [16]; responses follow the framework logic of Section 3.

5.2. The five phases

Phase 1 — Student-needs diagnosis. A short diagnostic block establishes each cohort's baseline: A current skill-demand scan for the relevant Yunnan sectors, a self-assessment of entrepreneurial attitude and perceived behavioral control, and a readiness baseline. This phase identifies gaps against the demand evidence and personalizes later activity [14,24].

Phase 2 — Sustainability-oriented entrepreneurship learning. Core teaching builds the high-demand employability competencies (Section 4.2) alongside the sustainability competencies of systems, futures and values thinking, framed around SDG-aligned local value creation [6,8]. The aim is an entrepreneurial mindset that is responsible by default [5,21].

Phase 3 — Opportunity-recognition and local problem-mapping projects. Students work in teams to scan real local problems and unmet needs, drawing deliberately on the long tail of under-served skills (Section 4.5) to find differentiated opportunities. Structured opportunity-recognition activity converts the concentration evidence into venture ideas [15,34].

Phase 4 — Enterprise-supported mentoring and practice. Work-integrated learning — placements, incubation and mentoring by partner firms — gives ideas a reality test and develops the practice-based competencies that most strongly support employability [22,23]. Enterprise co-design operationalizes industry–education integration [2,18].

Phase 5 — Entrepreneurship-readiness and employability-oriented assessment. Assessment is authentic and outcome-oriented: Business-plan quality, an internship mentor evaluation, a competency portfolio and a readiness re-measure. Results feed the continuous-improvement loop back to Phase 1, so the program is renewed as the market shifts [17].

Table 13. Translation of the evidence into operational training modules.

Phase / module	Indicative credit h	Teaching activities	Assessment method	Teacher / enterprise role	Yunnan-relevant example
P1 Needs diagnosis	16	Skill-demand scan; self-assessment workshop	Diagnostic report; baseline readiness scale	Teacher facilitates; firms share demand insight	Map tourism-sector skill gaps in a prefecture
P2 Sustainability-oriented learning	48	Lectures; case studies; SDG venture clinics	Concept tests; sustainability-case analysis	Dual-teacher delivery; guest practitioners	Low-impact agritourism product design
P3 Opportunity-recognition projects	48	Local problem-mapping; field scans; ideation	Opportunity dossier; pitch	Teacher coaches; firms pose real problems	Rural e-commerce niche for a county crop
P4 Enterprise mentoring and practice	80	Placement; incubation; mentoring	Prototype / MVP; mentor logbook	Enterprise mentors lead; teacher reviews	Cross-border trade micro-venture pilot
P5 Readiness and employability assessment	16	Capstone; portfolio review; reflection	Business-plan quality; mentor evaluation; portfolio	Joint school–enterprise assessment panel	Cultural-industry venture business plan

Note. Credit hours are indicative and should be calibrated locally. The examples are illustrative; the rural e-commerce cases are informed by Lin et al. [9,10].

5.3. Limitations

Several limitations bound the contribution and should be read alongside the framework:

- The dataset is not Yunnan-specific; the regional findings rest on an illustrative mid-sized regional case (Region 6) selected as a structural analogue, not on verified Yunnan administrative data, and they should not be read as direct measurements of the province.

- The benchmark reflects general online recruitment rather than higher-vocational graduates only, and may under-represent informal, agricultural and very small-enterprise employment that is significant in Yunnan.
- Skill, occupation and region entities are anonymized identifiers, so the analysis demonstrates a reproducible methodology rather than naming specific skills.
- Social and entrepreneurial intention and skill-demand alignment are proximal indicators of entrepreneurship readiness and career agency; they are not the same as actual employability, and no employment-rate, employer-evaluation or graduate-tracking data are included.
- No intervention or training program was directly tested; the framework is a design proposition, not a validated treatment.

5.4. Future research

The natural next step is a primary validation in Yunnan HVE institutions. A concrete design would collect province-specific, named skill-demand data and re-run the pipeline of Section 4 on it, then test the framework with a controlled study. Recommended elements are a pre-test–post-test design with experimental and control groups; measurement of sustainability values, opportunity recognition, entrepreneurial self-efficacy, social entrepreneurial intention, business-plan quality, internship-mentor evaluation, employment status and venture-initiation behavior; and 6-month and 12-month follow-ups to capture downstream outcomes. Depending on the achieved sample size, analysis could use multiple regression or ANCOVA for the experimental contrast and structural equation modelling or PLS-SEM for the readiness pathways [12,14]. Pairing such primary data with continuously updated labor-market intelligence would also allow the sustainability loop to be evaluated directly, testing whether periodic re-scanning keeps provision aligned as the market shifts [17].

6. Conclusion

This study set out to ground entrepreneurship training for Yunnan higher vocational education in observed labor-market behavior rather than assumption. Using the Job-SDF benchmark as a secondary foundation, it characterized the structure and dynamics of job-skill demand — rising but cyclical, highly concentrated, regionally uneven, structurally volatile and organized into competency bundles — and translated those patterns, through an explicit and auditable mapping, into a five-phase sustainable entrepreneurship training framework with a continuous-improvement loop. The contribution is a preliminary, evidence-informed framework, not a validated intervention: The demand evidence supports what to teach and when, while the psychological drivers of readiness rest on the wider literature, and graduate employability remains a distal outcome the framework is designed to support but cannot yet demonstrate. Its value lies in making subsequent primary research in Yunnan more focused and economical, and in offering provincial HVE institutions a renewable, demand-calibrated way to design entrepreneurship-readiness provision that is responsible by default and matched to a developing regional economy.

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Data availability statement: This study analyses publicly available secondary data. The Job-SDF benchmark is described in [16] and distributed by its authors at github.com/Job-SDF/benchmark. All tables and figures were computed from the dataset and its accompanying analysis; no new primary data were generated.

Generative AI disclosure: Generative AI tools were used to support drafting, figure generation and language editing. All data interpretation, the framework and the final text were reviewed and verified by the author(s), who take full responsibility for the content.

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