Journal of Education and Educational Research
ISSN: 2957-9465 | Vol. 21, No. 2, 2026

Epistemic Integration for Quality at Scale in Vocational Undergraduate Education

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Abstract: Epistemic integration offers a way to specify the intellectual demands of vocational undergraduate study: students use concepts and evidence to justify a professional decision. This article develops that argument through a conceptual synthesis, two national teaching standards, and descriptive statistics from five education bulletins. China's vocational undergraduate enrollment rose from 129,300 in 2021 to 518,300 in 2025 as the number of providers increased from 32 to 87. Private institutions accounted for 68.8% of providers at the start of the period and 27.6% at its end. Against this changing institutional background, the proposed assessment procedure follows a student's reasoning through the framing of a problem, explanation of choices, verification of results, and application to changed conditions. Occupational performance and intellectual justification receive separate judgments based on evidence from the same learner and task. Curriculum coherence, joint educational provision, progressive practice, and teaching team capability form the organizational basis for this work. Their 24 diagnostic indicators connect program arrangements to evidence of learning. Three propositions specify how task design, guidance, and responsibility for review are expected to support integration. The research agenda concerns the consistency of these judgments and their use in improving subsequent learning opportunities.

Keywords: Vocational Undergraduate Education; Epistemic Integration; Quality at Scale; Administrative Statistics; Authentic Assessment.

1. Introduction

Bachelor-level vocational provision has become an increasingly substantial part of China's education system. Ministry of Education bulletins put vocational undergraduate enrollment at 129,300 in 2021, when the sector comprised 32 institutions. By 2025, the corresponding figures were 518,300 and 87 [1–5]. More students and a broader range of providers now participate in advanced vocational learning. Program design consequently has to address how occupational relevance and the intellectual demands of a degree are sustained across diverse institutional settings.

This educational task has a clear policy basis. The revised Vocational Education Law gives vocational and general education equal importance and provides for vocational study at undergraduate and higher levels [6]. Reform of programs, curricula, teaching materials, teachers, and practical learning is brought together in the Ministry's 2026 guidance [7]. Scholarship on institutional positioning adds a further consideration: academic status hierarchies and industrial engagement shape how vocational undergraduate institutions develop [8]. Quality therefore concerns the relationship between educational purpose and the conditions under which students undertake professional work.

Epistemic integration refers here to the use of systematic concepts and standards of evidence in situated professional judgment. An occupational task presents a problem, imposes constraints, and gives a student's decisions practical consequences. Intellectual depth becomes visible in the student's explanation of those decisions and in the ability to revise them as conditions change. When a task calls for both competent action and a reasoned account of that action, the two attributes of vocational undergraduate education become observable within the same learning process.

The analysis starts with the pattern of national expansion and uses it to frame a question about learning. It then develops an account of how occupational tasks support explanation, verification, and transfer, before specifying how programs can assess that connection. The practical outcome is a protocol combining 24 diagnostic indicators with paired evidence from student work. Each part serves a distinct purpose: administrative records describe sectoral change, policy documents establish educational expectations, and conceptual reasoning identifies relationships for investigation.

2. Evidence Base and Descriptive Analysis

2.1. Sources and analytical procedure

Five national education statistical bulletins supply the quantitative evidence for 2021–2025 [1–5]. The series in Table 1 covers institutions, vocational undergraduate students, private institutions, and the two admissions categories reported separately in the bulletins. Published student counts use units of ten thousand; multiplying those entries by ten expresses them in thousands. Provider totals are reported as whole institutions. Each reference identifies the observation year and the publication year, together with the issuing authority and an accessible official or institutional copy.

The published rounded observations are the inputs to every calculation. Cumulative growth takes the ratio of the 2025 value to the 2021 value, subtracts one, and expresses the result as a percentage. For the compound annual rate, the fourth root of that ratio gives the annual growth factor across the four intervening years. Subtracting one and expressing the result as a percentage yields the reported rate. Private shares use each year's private and total institution counts. Figure 1 divides each observation by its own series' 2021 value and multiplies by 100, placing the three series on a common base. These operations describe the sector as recorded in successive

annual bulletins.

The conceptual analysis uses theory synthesis [15] to connect accounts of vocational knowledge [9] with learning in the workplace [10]. Boundary crossing [11] provides a way to examine the movement between educational and occupational practices. Curriculum design is considered through constructive alignment [12] and the relationships between school and work [13], with authentic assessment [14] informing the treatment of student evidence. The project's June 2026 report provides the starting structure of four domains and 24 indicators [16]. The present analysis develops their educational rationale through epistemic integration and translates it into an assessment procedure and propositions for testing.

Table 1. National vocational undergraduate education statistics for 2021–2025

Year and source	Institutions	Bachelor students (000)	Intake A (000)	Intake B (000)	Private institutions
2021 [1]	32	129.3	41.4	15.1	22
2022 [2]	32	228.7	76.3	33.1	22
2023 [3]	33	324.7	89.9	46.7	22
2024 [4]	51	406.8	109.6	44.1	23
2025 [5]	87	518.3	154.1	46.6	24

Notes: Student counts reflect the rounded values in the bulletins. Intake A denotes the reported vocational undergraduate admissions category. Intake B records admissions from associate-level study. The enrollment total measures the student stock, and A and B measure annual intakes. Provider totals cover the institutional category, including institutions that also offer programs at other levels. Sources: Ministry of Education statistical bulletins [1–5].

2.2. Expansion patterns and their educational significance

The annual snapshots reveal a difference in the timing of student and institutional expansion. During 2021–2023, the provider count moved from 32 to 33, a 3.1% increase, as enrollment grew by 151.1%. Over 2023–2025, institutions increased by 163.6% and student numbers by 59.6%. Taking 2021–2025 as a whole, enrollment grew by 300.9% to 4.01 times its initial level; the corresponding compound annual growth rate was 41.5%. Intake A recorded growth of 272.2%, compared with 171.9% for institutions. The membership of the provider category and the mix of programs are those reported in each year's bulletin [1–5].

The composition of provision also shifted. There were 22 private institutions in 2021 and 24 in 2025, accounting respectively for 68.8% and 27.6% of all providers. Using the unrounded shares gives a difference of 41.2 percentage points. Thus, the changing distribution of provider types accompanied the sector's increase in size [1,5].

Admissions bring a further consideration into program planning. The separately reported upgrade route enrolled 46,600 entrants in 2025. This represented 23.2% of the combined 200,700 entrants in the two published admissions categories [5]. For curriculum teams, these figures give a concrete reason to examine prior learning and progression by entry route. Common graduate expectations can then be connected to the preparation and support students need for demanding tasks.

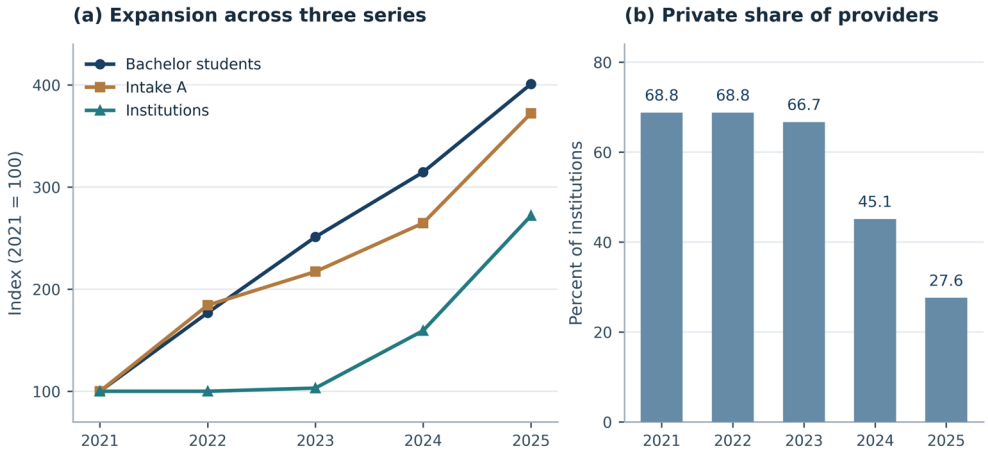


Figure 1. Sectoral expansion and provider composition derived from Table 1. Panel a uses 2021 = 100 for the three expansion series; panel b reports private institutions as a percentage of all providers. Sources: [1–5]

2.3. Statistical Scope and Interpretation

Interpretation depends on the coverage of each statistical category. Vocational undergraduate enrollment counts students at bachelor level. Average institutional size, by contrast, includes ordinary undergraduate, vocational undergraduate, and short-cycle students, while the institutional student–teacher ratio uses equivalent student numbers [5]. Each series is therefore interpreted within its published scope. These national observations establish the context for reform; assessment of educational quality rests on direct evidence of what students learn and produce.

3. Epistemic Integration as a Quality Mechanism

3.1. Connecting Knowledge and Professional Action

Access to concepts gives vocational learners a basis for interpreting work and extending their understanding beyond an immediate task [9]. Workplace learning research places the development of expertise within interactions among knowledge forms and learning settings [10]. Boundary crossing draws attention to the learning that occurs as students engage with different practices [11]. These accounts gain practical form through constructive alignment, which relates outcomes to learning activities and assessment [12], and through curriculum design that attends to relationships between school and work [13]. An integrated curriculum makes knowledge available at the point where students need it for professional judgment.

The educational demand lies in the decisions inside a task. A complex occupational problem brings interacting constraints and several defensible responses into play, making verification part of the work itself. The size of a project gives a partial account of that demand. Competing objectives or a change in available information require students to reconsider the basis of their decisions. At bachelor level, an explanation should identify the relevant principles, relate the evidence to the selected response, and show how the reasoning changes with the situation. These expectations concern learning within the varied settings of higher vocational and professional education [17].

Framing makes the occupational problem explicit, including the standards to be met, the people affected, and the constraints on action. Students explain a possible response by identifying its conceptual basis and the assumptions behind it. Verification then asks how its performance compares with the intended result. Transfer becomes visible when a changed condition prompts a further decision: the student identifies which principles still hold and how they support an adapted response. A revised scenario or oral defense provides a practical setting for examining this reasoning.

An epistemic trace records the reasoning associated with a professional decision. It brings the task brief and alternatives into a portfolio alongside the implementation record, verification, and the student's explanation, allowing an assessor to follow the connection between reasons and results. Their relationship is the object of assessment. Research on authentic assessment highlights learner agency and social collaboration [14]. Within the proposed approach, assessors examine how each student's reasoning supports the occupational performance represented in a shared product.

3.2. Anchoring the Mechanism in National Program Standards

Intelligent Manufacturing Engineering Technology and Modern Logistics Management provide two documentary examples from the 2025 national teaching standards [18,19]. Each expects systematic knowledge to inform demanding professional work, although the work takes different forms. Table 2 sets the standards' stated expectations beside the portfolio evidence proposed in this article. This comparison locates the argument in both engineering and service-oriented vocational learning.

Table 2. National standards and proposed evidence of epistemic integration

Program and source	Specified expectations	Proposed portfolio evidence
Intelligent Manufacturing Engineering Technology 260102 [18]	Integrated knowledge; complex on-site problems; critical thinking; real production projects	Diagnostic or design product linked to alternatives, verification, and individual explanation
Modern Logistics Management 330802 [19]	Logistics data decisions; system analysis and design; complex professional problem solving	Operational plan linked to assumptions, tradeoffs, evidence, and a changed-condition defense

Note: The standards are paraphrased in the middle column. The final column gives proposed assessment evidence developed from those expectations. The two programs were selected as complementary documentary examples.

The logistics standard makes the practical setting especially clear. It specifies at least 3,200 teaching hours, generally allocates at least 60% to practical teaching, and normally provides for at least six months of internship. It also accommodates varied graduation design outputs [19, Sections 8.2 and 11.2]. Within such provision, professional products and decisions offer a basis for examining intellectual depth. The proposed assessment procedure makes the student's explanation and supporting evidence part of that examination.

4. Organizing and Assessing Quality at Scale

4.1. Four Domains and 24 Diagnostic Indicators

The four domains describe how a program supports this learning. Curriculum coherence connects graduate capabilities with prerequisite knowledge and the courses, projects, and assessments through which it develops. Joint educational provision assigns institutions and occupational partners specific responsibilities for task design, guidance, and judgment. Through progressive practice, students encounter increasing complexity and exercise greater justified autonomy. Teaching team capability brings the required conceptual, occupational, design, and assessment expertise into this sequence. Figure 2 shows the domains and their 24 indicators. Table 3 identifies the priority evidence associated with each group of six [16].

A reviewer can follow one demanding project through the program to examine how the domains work together. The curriculum supplies the prior knowledge students draw on, while guidance helps them use it in the task. Teaching teams need time to develop workplace activity into teaching and opportunities to work with occupational partners. The partnership gives access to the work from which suitable tasks are developed. Following this sequence identifies where stronger connections are needed and gives resource and responsibility decisions a common reference in graduate capability.

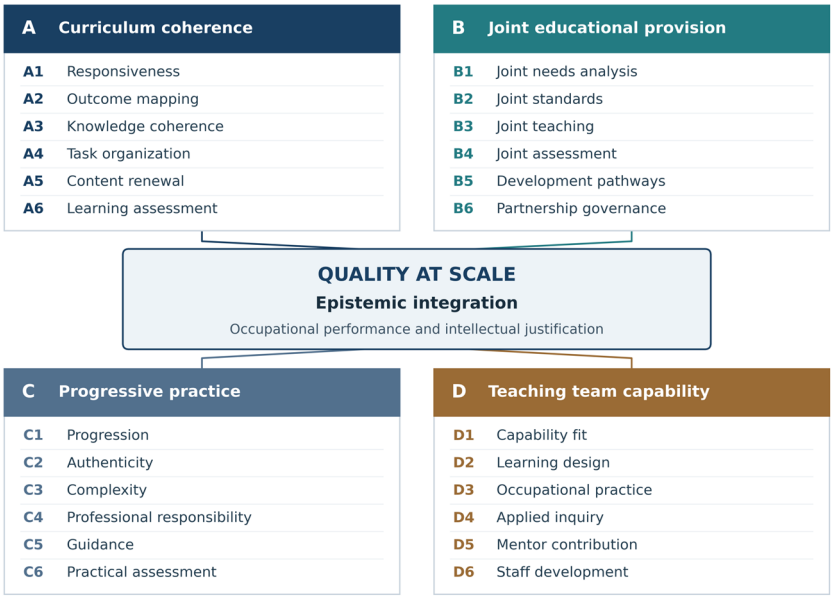


Figure 2. Structure of the four organizational domains and 24 diagnostic indicators. Six indicators belong to each domain (A1–D6), linked by a shared purpose of epistemic integration for quality at scale. Adapted from [16]

Table 3. Compact diagnostic framework with six indicators per domain

Domain	Six diagnostic indicators	Priority evidence
Curriculum coherence	A1 Responsiveness; A2 Outcome mapping; A3 Knowledge coherence; A4 Task organization; A5 Content renewal; A6 Learning assessment	Outcome–course–project map connected with assessed student work
Joint educational provision	B1 Joint needs analysis; B2 Joint standards; B3 Joint teaching; B4 Joint assessment; B5 Development pathways; B6 Partnership governance	Named contributions, mentor records, and moderated professional judgments
Progressive practice	C1 Progression; C2 Authenticity; C3 Complexity; C4 Professional responsibility; C5 Guidance; C6 Practical assessment	Task sequence, verification records, and individual explanations
Teaching team capability	D1 Capability fit; D2 Learning design; D3 Occupational practice; D4 Applied inquiry; D5 Mentor contribution; D6 Staff development	Capability matrix and documented translation of professional work into learning

Note: Indicators A1–D6 are adapted from the project report [16]. Review follows an indicator from the intended provision to its implementation and the associated evidence of learning or improvement. Pilot reviews examine agreement among reviewers before consequential use

4.2. A Paired Evidence Protocol

A task brief establishes occupational and epistemic criteria together. The occupational judgment concerns fitness for purpose, adherence to technical standards, professional responsibility, and the consequences of the result. The epistemic judgment concerns the accuracy of concepts, stated assumptions, consideration of alternatives, verification, and transfer. Both judgments draw on the same task and refer to identifiable learners. Retaining each judgment gives the teaching team a basis for examining performance, justification, and the connection between them.

Implementation starts with agreement between the course team and partner on the task, degree-level expectations, and permissible support. Evidence gathered during the work links the product or response to a decision record and an individual explanation. A consequential variation in the task tests the reach of that explanation. Assessors then compare judgments against shared criteria and discuss cases receiving different ratings. Graduate outcomes and professional standards supply the minimum criteria. The procedure's reliability and educational consequences are subjects for empirical validation.

In an illustrative logistics task, students plan distribution under changing transport conditions. The plan is accompanied by an account of demand assumptions, priority rules, routing decisions, and verification. Introducing a changed delivery constraint allows assessment of how students adapt their reasoning. The occupational and epistemic judgments then point to a suitable next activity, such as extending the conceptual explanation or carrying out further operational verification.

4.3. Feedback and Developmental Judgment

A review cycle follows five connections: needs to outcomes, outcomes to curriculum, curriculum to implementation, implementation to assessment, and assessment to improvement. At each connection, a named actor takes responsibility for reconsidering the earlier decision. The improvement record documents the issue identified, its selected explanation, the action owner, and the evidence due for review. Examining the consequences of that

action in the next cycle links institutional quality work to actual teaching and learning.

National and program requirements establish the conditions against which regulatory compliance is judged [20]. Developmental review adds a qualitative account of how provision operates over time. Its categories are established provision, coordinated operation, integrated learning, and sustained contribution. Reviewers examine the relationship between arrangements and their evidence across successive cycles, recording the material available for each indicator and how complete it is. The outcome is a profile of provision and learning that keeps occupational performance and intellectual justification visible as separate, related judgments.

5. Discussion and Research Agenda

5.1. Linking Expansion with Educational Depth

A larger sector has to sustain educational expectations across programs with different institutional histories. The annual series also shows that student numbers and the provider base expanded at different rates. For reviewers, the student's handling of a professional task provides a common point of reference. The product shows the action taken; its explanation identifies the knowledge used and the grounds for accepting the result. Reading these together gives epistemic integration a specific meaning in program review.

The project's four-domain structure [16] supplies the organizational starting point. The development proposed here specifies the evidence a reviewer would follow through that structure, from a student's action to the reasons and checks supporting it. Responsibility for responding to the resulting judgment is also assigned. Professional differences remain relevant to the evidence selected. A manufacturing diagnostic record and a logistics decision portfolio retain their respective standards while each makes explanation and verification available for review.

5.2. Three Propositions

Proposition 1: Transfer is expected to relate more closely to professional performance when occupational tasks require students to justify decisions conceptually and verify their results. Repeated use of knowledge in decisions with practical consequences provides the proposed explanation. Independent portfolio ratings and subsequent tasks with changed conditions offer a way to examine the relationship. Comparisons should account for prior attainment and task difficulty.

Proposition 2: Access to complex tasks is expected to contribute more to integrated learning when conceptual teaching and occupational mentoring are coordinated. Within a demanding assignment, guidance helps students interpret the work and decide which knowledge is relevant. A comparison of programs could examine how these guidance practices relate to student reasoning, taking workplace conditions and participant selection into account.

Proposition 3: Assessment findings are expected to lead more readily to revised learning opportunities when decision responsibilities are assigned and joint review occurs at scheduled intervals. A longitudinal study could follow a specific finding through the action chosen and the teaching subsequently provided. Examining the student work that follows would then show how the program responded to the educational judgment.

5.3. Implementation and Validation

An initial application can focus on a few graduate capabilities and map their development through a sequence of projects. Reviewers select work showing ordinary and advanced performance and record the selection procedure. Preparatory support for each entry route connects students' starting points with the common expectations for graduation. Such an approach also gives space to professional agency, further learning, and responsible participation, consistent with UNESCO's account of TVET [21].

Initial validation examines whether reviewers understand the indicators consistently, can use them in practice, and reach comparable educational and occupational judgments. Studies using direct learning evidence can then test the propositions and assess their applicability across programs and institutions. Following assessment decisions into subsequent teaching and student work connects the evaluation of the procedure with its educational consequences.

6. Conclusion

Between 2021 and 2025, China's vocational undergraduate sector expanded in enrollment and institutional numbers while its provider composition changed. The educational task accompanying this growth is to sustain the connection between professional action and reasoned judgment. Epistemic integration places that connection inside the occupational task and makes it available for assessment through linked evidence of performance and explanation. Four domains and 24 diagnostic indicators organize the supporting provision. The paired judgments and assigned improvement responsibilities give programs a basis for review, while the three propositions define relationships for empirical study across learners and institutional settings.

Data Availability

The aggregate observations are reproduced in Table 1, with source links in references [1–5]. Section 2.1 describes calculations using the published rounded figures. The institutional project report cited as [16] informs the conceptual development. Published national aggregates constitute the study's quantitative evidence.

Acknowledgments

This article draws on the 2025 Vocational Education Research Project of the Shandong Provincial Society for Technical and Vocational Education, Research on Pathways for High-Quality Talent Development in Vocational Undergraduate Education from the Perspective of Dual Attributes (Project No. KYKT2025G197).

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