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How vocational education contributes to regional collective capability and industrial upgrading

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Article

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Abstract

Regional partnerships can circulate knowledge without developing the capacity to address a further problem collectively. This distinction complicates claims that vocational education supports industrial upgrading through expanded skill supply and education-industry cooperation. This conceptual article explains how individual learning may become sustained organisational action and how diffusion may contribute to regional collective capability. A selective, theory-guided comparison integrates accounts of skill formation and use, absorptive capacity and regional learning, with published Chinese research providing an institutional setting rather than a newly investigated case. Four processes are distinguished: capability formation, demand translation, capability use, and regional diffusion and accumulation, with feedback throughout. Regional collective capability is defined through interdependent tasks and the continuing usability of relationships, rules and collaborative experience, rather than administrative co-location, network persistence or the independent adoption of knowledge. Three conditional propositions address opportunities for use and team learning, continuity across organisational boundaries, and the fit between learning time and support periods. The argument identifies permission, trial responsibilities, access to expertise and opportunities for renewed verification as questions of governance. It also distinguishes collective capability from upgrading: joint action can maintain existing production, while independent adoption can support technical improvement without a collective pathway. No original empirical data or causal estimates are reported, and the source comparison is not systematic. The framework offers an explanation to be investigated and questions for allocating educational and collaborative support. Its application must consider who can participate, who benefits and whether workers' continuing development and mobility are preserved.

Introduction

A regional partnership can provide shared equipment, trained personnel and access to expertise without becoming able to address a further production problem collectively. Knowledge may circulate while the capacity to organise joint action remains weak. This distinction matters for understanding how vocational education contributes to industrial upgrading: increasing the supply of skills and connecting organisations are not equivalent to sustaining the use of knowledge within firms or across them.

The relationship involves several levels of action. Individuals develop occupational knowledge and judgement. Firms organise their use alongside equipment and complementary expertise. Participants in a production and learning space may then have to coordinate interdependent tasks. Human capital theory, absorptive capacity and regional learning perspectives illuminate different parts of this relationship (Becker, 1964; Cohen and Levinthal, 1990; Florida, 1995). Skills ecosystem research connects formation and use with work, markets and institutional support (Finegold, 1999; Wedekind et al., 2021). None of these connections warrants assuming that individual competence, organisational action and regional collaboration are the same outcome at different sizes.

The article develops the idea of regional collective capability to distinguish a continuing capacity for joint problem-solving from three neighbouring phenomena: the completion of a project, the persistence of a network, and the independent adoption of knowledge by several firms. The proposed capability rests on complementary knowledge, workable relations and rules, and experience that participants can mobilise in subsequent tasks. It is regional insofar as these arrangements support continued action within a connected industrial space. Administrative co-location is neither its definition nor sufficient evidence of its existence.

China provides an institutional setting, rather than a newly investigated case. Its Education Powerhouse Development Plan for 2024–2035 promotes city-level education-industry consortia and sectoral communities (Central Committee of the Communist Party of China and State Council, 2025). These arrangements bring vocational colleges, employers and public agencies into contact. Published studies already address standards translation, reciprocal adaptation, shared resources and feedback (Wen et al., 2026; Huo, 2026). Research on employer participation and consortia also raises questions about the content and continuity of cooperation (Zhao et al., 2026; Zong, 2026). Their observations cannot establish the capability-conversion relations proposed in this article.

The research question is how vocational learning can contribute to organisational and regional capability, and under what conditions these contributions may support industrial upgrading. The argument distinguishes capability formation, demand translation, capability use, and regional diffusion and accumulation. Two transitions receive particular attention: individual use becoming sustained organisational action, and knowledge diffusion becoming reusable collaborative experience. A third concern is whether the time needed to learn corresponds to the period for which support has been agreed.

The contribution lies in specifying the task, relational and temporal conditions of these transitions, while preserving alternative routes to upgrading. Firms can improve through independent adoption, and collective action can maintain existing production without upgrading it. The article consequently offers three conditional propositions, not a claim that collective capability is a universal mediator or that education alone determines regional development. VET also serves learners' continuing development and occupational choice; these purposes cannot be reduced to a locality's immediate productive interests (Billett, 2011; McGrath and Powell, 2016).

Conceptual research design

This is a conceptual study using a selective, theory-guided comparison of published literature. Jaakkola (2020) argues that conceptual articles need an explicit design and a justified role for each theoretical perspective. Here, the focal problem is the relationship between learning, sustained organisational action and continued collaboration. Theories are selected for their different explanatory functions, not because they supply interchangeable labels for the same process.

The comparison proceeds through four analytical operations in the article. First, the constructs are defined at individual, organisational and regional levels. Second, accounts of skill formation and use, knowledge adoption and regional learning are compared in terms of their actors, actions, conditions and outcomes. Third, two cross-level transitions are examined: individual use becoming sustained organisational action, and diffusion becoming reusable joint experience. Fourth, propositions are developed and their boundaries checked against analytical counterexamples. These operations describe the argument presented here; they are not a retrospective claim that a preregistered search or independent coding procedure was conducted.

Source selection is purposive. Foundational works provide the theoretical premises; research on VET, workplace learning and regional skills systems informs the mechanisms and their contextual restrictions. Recent Chinese studies address curriculum translation, teacher development, employer participation, consortia and timing. Policy documents describe intended institutional arrangements. No policy statement is treated as evidence that an arrangement has produced its intended result. Table 1 specifies the role assigned to the principal theoretical accounts, including the cross-level question to which each contributes.

Table 1
Theoretical accounts and their analytical roles

Account and selected sources	Role in this article	Question requiring further explanation
Human capital and vocational learning (Becker, 1964; Billett, 2011)	Formation of knowledge, practical skill and judgement	How does available learning enter supported use?
Skills ecosystems (Finegold, 1999; Wedekind et al., 2021)	Relationships connecting formation, demand, use and institutions	Which arrangements sustain action within and across organisations?
Absorptive capacity (Cohen and Levinthal, 1990)	Recognition, assimilation and application of external knowledge	How does initial use become a continuing capacity for a team?
Regional learning and innovation (Florida, 1995; Boschma, 2005; Lund and Karlsen, 2020)	Connections, proximity and contextual institutional roles	When does circulation support renewed interdependent work?

Note: Author's conceptual comparison. The questions identify the analytical work undertaken here, not omissions attributed to every contribution in these literatures. The table is not a systematic review or an empirical comparison of theories.

Published observations are retained at their original scale. Sauli et al. (2021) and James Relly and Laczik (2022) inform connections between educational and workplace learning in particular systems. Lund and Karlsen (2020) and Wedekind et al. (2021) inform regional relationships and the contingent role of educational institutions. Zhao et al.'s (2026) employer survey concerns firms recommended by vocational institutions, and Zong's (2026) investigation covers 31 consortia across seven provincial-level

jurisdictions. These studies motivate questions about participation and continuity; they do not test the propositions developed below or provide national effect estimates.

The counterexamples are logical probes, not observed cases. They include skilled employees with restricted task access, successful individual use without sustained team practice, independent adoption across firms, and continued collaboration that maintains rather than upgrades production. They help determine what the framework must distinguish. There is no exhaustive database search, systematic screening flow, pooled estimate or original interview, survey or intervention. The analysis is therefore not a systematic review or an empirical comparative case study. Its transparency rests on specifying source functions and tracing the reasoning from constructs to propositions.

OpenAI ChatGPT/Codex assisted with English translation, language editing, restructuring of the conceptual argument, and retrieval of public source information. No empirical data were generated. The author is responsible for checking the sources and arguments and for approving the final manuscript.

Conceptual foundations and the unit of explanation

Vocational learning within a skills ecosystem

The skills ecosystem perspective helps explain why improvements in educational provision can coexist with limited skill use. When work offers few opportunities for judgement, further learning or progression, additional training may not change what people are allowed to do. Conversely, demanding tasks and opportunities to learn can encourage investment in skills (Finegold, 1999). This relationship directs attention to the organisation of work rather than locating every difficulty within the college. It does not establish that more complex tasks are automatically better learning environments: support, safety and the learner's preparation still matter.

School and workplace learning also offer different resources. Sauli et al. (2021) examine perceived connections and disconnections in Swiss initial VET. Their reported findings include opportunities to use school learning beyond workplace routines and to bring workplace situations back into classroom reflection. This supports examining the relationship between learning settings rather than assuming that placement itself integrates learning. James Relly and Laczik's (2022) English apprenticeship study similarly foregrounds communication and trust between colleges, employers and apprentices. These studies concern particular systems and participants, not a universal prescription for Chinese VET.

For the present analysis, demand translation is consequently an educational judgement as well as an information process. A college must interpret which knowledge should remain broadly applicable, which technical content needs updating, and which activities can reasonably be learnt at work. Employer information is important, but an employer's immediate staffing request is not itself a curriculum. The interests of current learners and future occupational development remain part of that judgement.

Individual and organisational capability

Individual vocational capability refers here to occupational knowledge, practical skill, problem-solving and judgement that a person can draw on in work and further learning. Organisational production and learning capability refers to the capacity to organise people, equipment and knowledge so that tasks can be sustained and adapted. The term capability is used in this task-oriented, organisational sense. The paper does not operationalise a normative capability approach or treat an employer's productive interests as a complete account of a learner's wellbeing.

The difference between the levels is not simply a difference in size. A competent employee may be unable to share an effective approach because colleagues lack time, supervision or access to the task. Conversely, a team may sustain a practice through complementary expertise even though no member possesses all the relevant knowledge. Written procedures can support continuity, but so can guided practice, joint operation and continuing access to expertise. Organisational capability does not require knowledge to become independent of people. It requires arrangements that make continued action less dependent on an unplanned, isolated performance.

Cohen and Levinthal's (1990) account of absorptive capacity concerns recognising, assimilating and applying external knowledge. It provides a basis for distinguishing a firm's willingness to join a partnership from its ability to make use of the knowledge involved. Access to a trained employee, a technical adviser or a college service is only an entry point. The task must be understood and the proposed practice accommodated within production. Lewis (2025) also links technicians' work with technology deployment and incremental improvement, placing practical skill within innovation processes rather than outside them.

Regional collective capability

Regional collective capability refers to the capacity of multiple participants, drawing on continuing relationships and rules within an industrial space, to identify and address technical or skill problems jointly and to reuse collaborative experience in later tasks. Its collective dimension rests on complementary knowledge, a division of work and joint verification. Its regional dimension concerns where these arrangements sustain connected production and learning. Relevant expertise can come from outside the locality; the concept does not imply regional self-sufficiency.

This definition builds on regional skills ecosystem and innovation accounts. Wedekind et al. (2021) examine horizontal collaboration, institutional support and mediation, while questioning whether vocational institutions necessarily perform an anchoring role. Lund and Karlsen (2020) discuss vocational institutions in two Norwegian manufacturing regions. These sources support investigating who connects learning and production under particular conditions, rather than assigning the role to a college merely because a regional partnership exists.

The unit of explanation is an interdependent task and the arrangements through which participants can carry it forward. An enterprise may possess expertise that becomes useful to another without either enterprise being able to resolve the whole problem alone. The collective capacity depends on how the

participants identify the relevant expertise, sequence their work and interpret results from different settings. It is not an additional stock of knowledge located above the firms, and it does not mean that all firms possess the same competence.

Four distinctions prevent the construct from being inferred too readily. A temporary project can complete one task but leave no usable arrangements for another. A network can maintain contact without allocating responsibility for joint work. Diffusion can enable separate adoption without coordinated verification. An aggregate of capable firms can still fail to address a problem requiring complementary action. Regional collective capability concerns the continuing usability of relations, rules and experience for that last kind of task. Table 2 locates this distinction within the four conversion processes.

Table 2
Capability conversion and the distinction between outcomes

Process	Relevant action	Interruption to distinguish	Outcome not established by participation alone
Capability formation	Learners develop knowledge and judgement through guided tasks	Resources exist but learning is poorly mediated	Individual vocational capability
Demand translation	Work information informs educational decisions	Vacancies substitute for learning needs	Educationally justified task and content selection
Capability use	Employees use knowledge and teams sustain relevant practice	Initial use occurs without organisational continuity	Organisational production and learning capability
Regional diffusion and accumulation	Participants coordinate and reuse collaborative experience	Separate adoption continues without renewed joint work	Regional collective capability

Note: Author's conceptual synthesis. The order is analytical, not a fixed chronology; feedback can occur throughout. Teachers' technical services and continuing education can enter directly at workplace learning. Regional collective capability is not equated with industrial upgrading. The table is not a validated instrument.

Continuity is not a requirement that the same people or firms participate indefinitely. It can survive personnel change through guided participation, agreed access and knowledge of where relevant expertise is held. It may also enable authorised new participants to enter. The analytical question is whether a further task can draw on prior collaborative experience without simply rebuilding the earlier arrangements from nothing. This is a proposed distinction for inquiry, not a validated measurement scale or a claim that every new task must reuse old knowledge.

The concept remains narrower than a regional innovation system or an entire skills ecosystem. Those perspectives address a broader configuration of institutions, relations and activities. Regional collective capability specifies an action capacity that may arise within such a configuration. It also differs from

organisational absorptive capacity: firms still need to interpret and apply external knowledge, but a collective task requires decisions about complementary contributions, trial responsibilities and joint interpretation. The additional coordination cannot be inferred merely from the presence of absorptive capacity in each firm.

Industrial upgrading as a conditional outcome

Industrial upgrading is used here to distinguish sustained improvements in processes, product quality and technological application from more distant changes in industrial structure or value-chain position. VET-related learning may support the capacity to handle more demanding tasks and to coordinate production, but market access, investment, technology sources and industrial policy also affect these outcomes. A successful training activity or a firm's isolated quality improvement cannot, by itself, demonstrate regional upgrading.

Regional collective capability is one possible route, not a necessary intermediary in every case. Firms may improve independently after adopting similar knowledge. Joint action may also stabilise an existing process without moving towards more demanding production. Florida (1995) and Boschma (2005) provide reasons to consider learning relationships and proximity, while recognising that close connections can restrict access to different knowledge. The framework therefore explains conditions of learning and continuity rather than attributing regional economic change to education alone.

The capability-conversion framework

The framework distinguishes capability formation, demand translation, capability use, and regional diffusion and accumulation, with feedback throughout. Table 2 sets out their different explanatory functions. The sequence retains formation as an educational starting point, but it is not a chronology that every participant must follow. Demand translation may precede a programme, recur during teaching or follow workplace use. Graduates can enter the process through employment, while teachers' technical services and continuing education can connect directly with an existing workplace problem.

Capability formation

Capability formation includes the development of occupational knowledge, technical application, judgement and the ability to continue learning. Preparation for a current task matters, but reproducing established steps is not enough when equipment or responsibilities change. A broader knowledge base enables learners to interpret unfamiliar situations rather than only recall procedures. The educational purposes of VET also extend beyond employers' immediate requirements to people's continuing development (McGrath and Powell, 2016).

Teachers mediate between production requirements and activities through which students can learn. A task can be organised to reveal connections between equipment, process, quality and safety; assessment can then examine how a learner identifies a problem, selects an approach and responds to

an unexpected result. Authenticity is not an all-or-nothing property. Simulation and substitute tasks may be appropriate where costs or risks make direct participation unsuitable, provided that the differences from the workplace are made explicit. Access to new equipment is a resource for this work, not evidence that the pedagogical conversion has taken place.

Teacher learning is part of the same process. Participation in a technical project may provide experience, but teaching requires deciding what novices need to notice, what can be practised safely and how understanding can be assessed. Shen and Sun's (2025) study of selected teaching innovation teams provides examples of connections between enterprise work and teaching; its exemplary cases do not demonstrate a general teaching effect. A useful educational question is what changed in the task materials, guidance and opportunities for student judgement, rather than how many projects teachers joined.

Demand translation

Demand translation turns information about work into educational and training decisions. An employer may describe a staffing shortage or a recurring production fault. These reports require interpretation: is the difficulty temporary recruitment, changing technology, unclear responsibility or a skill that existing staff have little opportunity to use? Treating every reported difficulty as a curriculum deficit would conceal these differences. Wen et al. (2026) offer an account of translating industrial standards through occupational tasks and capability mapping into educational elements.

Consider fault diagnosis as an illustrative situation, not a collected case. Reading operational information, judging an anomaly and checking a proposed explanation could become linked learning activities. Their content would depend on equipment and process, while the educational decision concerns how learners develop an understanding that travels beyond one rehearsed fault. Employer participation can help clarify the judgement involved, but colleges still have to determine how it relates to the wider programme and the learner's preparation.

Vacancies and pay indicate current demand; technical standards and equipment changes can suggest changes in tasks. Neither a few employers' requests nor a long-term plan should be treated as a complete description. Colleges need to distinguish relatively stable knowledge from content that can be updated through modules, projects and continuing education. Xu et al. (2026) discuss timing differences within teaching reform. The relevant implication is not a universal response deadline, but the need to distinguish reasonable preparation for teaching from delay caused by unclear responsibilities.

Capability use and sustained organisational action

Use occurs when a learner or employee can bring knowledge and judgement to a real task. Whether this happens depends partly on task allocation, discretion, guidance and the firm's ability to understand the knowledge involved. The OECD's (2026) distinction between proficiency and skill use reinforces the

importance of examining these conditions separately. Having skilled people in a workplace is not sufficient evidence that they are using their skills.

A second transition occurs after use. Team members need opportunities to explain an approach, test its applicability and adjust their division of work. Procedures and training materials may preserve explicit elements. Guided operation and mentoring can carry judgement that cannot be adequately described in a document. Continuity can also involve knowing who to consult when an unusual condition arises. The important distinction is between a completed individual action and an arrangement through which the organisation can sustain and adapt relevant action.

Proposition 1

Where the available skills and technical tasks are broadly comparable, opportunities to use skills condition whether learning enters production; support for team learning and joint verification conditions whether that use develops into sustained organisational capability. An interruption before use is therefore analytically different from an interruption after use but before organisational continuity.

This proposition is conditional and untested. It is most relevant where work requires learning and adjustment, rather than the automatic repetition of a stable procedure. It does not suggest that every practice should be documented or that replacing an individual is the aim of learning. Complementary expertise and access to continuing guidance may be more appropriate than standardising all tasks. Colleges can contribute through technical services, mentoring and continuing education, but equipment suppliers and internal training staff may perform related functions. The college's contribution lies partly in connecting experience back with education; it is not exclusive.

Regional diffusion and accumulation

Diffusion widens access to experience through people, supply chains and shared services. Receiving a solution does not establish its suitability: firms may need to interpret it in relation to their own equipment, employees and processes. Technical staff and teachers can explain the basis of a practice and support local adjustment. Separate adoption by several firms may produce important improvements without requiring joint action.

Collective capability concerns a different relationship. Where tasks are interdependent, participants may need to diagnose a problem together, divide trials, compare results and revise an approach. Such collaboration can begin with the circulation of an existing solution, or with a problem for which no participant has a mature solution. The latter requires shared exploration rather than merely disseminating best practice. Accumulation occurs when experience and the relationships used to produce it remain available for a later task.

Proposition 2

Where firms face interdependent technical or skill tasks, knowledge diffusion contributes to regional collective capability to the extent that joint verification and later reuse of collaborative experience are supported by continuing organisational arrangements and rules. If the relevant relationships end with the project, independent diffusion may continue without a corresponding accumulation of collective capability.

Continuing coordination may reduce the need to reconstruct who holds relevant expertise and what previous trials established. Agreed access can allow participants to revisit an unresolved question when equipment or personnel change. This explains why continuity might support a further task, rather than defining capability merely as the persistence of contact. Stable relationships can still carry unsuitable experience or exclude needed expertise, so continuity alone is insufficient.

The proposition does not make collaboration necessary for every improvement. It specifies what would distinguish the collective pathway. Joint interpretation of variation across linked production stages, for example, involves coordination beyond several firms independently checking compliance with the same standard. This is an analytical illustration, not evidence from a new case. Whether the resulting capability supports upgrading requires further consideration of the tasks it enables. More complex production or improved product quality may be supported; routine maintenance of existing performance should not be relabelled as upgrading.

Feedback and the duration of support

Feedback need not wait for visible regional economic change. Difficulties in understanding a task, limited workplace use or a failure to continue guidance can inform curriculum and partnership decisions much earlier. Colleges can reconsider materials, teacher preparation and mentoring, while employers can reconsider work allocation. This makes educational feedback more specific than a general request for additional provision.

Learning may also extend beyond a delivery deadline. Staff may receive a solution but still need guided use; a receiving firm may require further adjustment after the original project has closed. Agreements that treat delivery, mastery and sustained use as the same event can leave responsibilities unclear.

Proposition 3

When the time required for learning exceeds the agreed period of support, initial delivery and use may be completed while subsequent capability accumulation remains vulnerable to interruption. The relevance of a longer support period depends on what learning remains unfinished and who can provide it; extending a contract is not, by itself, a remedy.

This proposition connects support periods with learning processes rather than prescribing a standard duration. Follow-up can be shared or renegotiated when the participants and task warrant it. It also matters who benefits. Employee mobility may move learning to another workplace or region and improve the individual's opportunities. Such movement cannot be treated simply as an educational failure or a

reason to restrict occupational choice. Benefits to learners, employers and the training locality need not coincide.

Conditions and interruptions in conversion

The framework does not imply that formal cooperation is ineffective. It explains why the content of participation matters. Providing placements, joining curriculum design, mentoring employees and sharing knowledge impose different requirements. Zhao et al.'s (2026) employer survey is relevant to perceptions and participation, but does not demonstrate the proposed organisational transitions. Zong (2026) identifies difficulties concerning costs, returns and resource-sharing rules within the consortia investigated. These observations support asking about the arrangements surrounding a task rather than using willingness to cooperate as a proxy for learning.

An interruption can occur after commitment but before use. A firm may welcome collaboration yet lack technical management or discretion for staff to implement a proposed change. It can also occur after use, when colleagues have no opportunity to learn together or continue guidance. These situations call for different support. Additional curriculum content will not necessarily resolve restricted work allocation, just as a partnership agreement will not supply the teacher preparation needed to teach an unfamiliar process.

Knowledge sharing raises a further condition. General methods may be suitable for joint discussion while specific parameters remain commercially sensitive. Relationships need arrangements for permission, access and the costs of trials and maintenance. A demand for complete openness may discourage participation; an overly closed network may prevent relevant knowledge or new participants from entering. Boschma's (2005) analysis of proximity helps frame this tension. The issue is whether the arrangements support an appropriate learning process, not whether the amount of shared material is always maximised.

Industrial structure also affects who can coordinate. A connected supply chain may offer shared standards and a lead firm, while dispersed small firms may require an industry association, shared mentors or mobile educational services. Neither arrangement establishes use automatically. Receiving firms still need opportunities and capacity to adopt or explore practices. Colleges likewise differ in resources and the complexity of the tasks they can support. Common expectations for technical innovation across all institutions would ignore their different educational purposes and service settings.

These conditions interact, but their interaction is not estimated in this paper. The proposed framework locates plausible interruptions and clarifies what additional evidence would be needed. It does not turn a set of favourable conditions into a sufficient recipe. In particular, ongoing collaboration can exclude less-resourced firms or learners, while a technically successful project may offer little learning to those expected to implement it. Judging conversion therefore includes asking whose participation and development have been supported.

Discussion

From connected organisations to continued collective action

Regional skills ecosystem and innovation accounts already connect learning with institutional relationships (Florida, 1995; Lund and Karlsen, 2020; Wedekind et al., 2021). The proposed contribution is to distinguish the circulation of knowledge from the continuing capacity to act jointly. Formal connections can provide access; organisational learning can sustain use within firms; collective capability concerns how complementary action remains possible across them. These distinctions allow a partnership to be valuable without attributing every possible regional outcome to it.

The mechanism of continuity is not simply that relationships last. Participants can preserve knowledge of who holds relevant expertise, which trials have already been undertaken, what differences in results mean, and who can authorise a further trial. Agreed access reduces the need to reconstruct these arrangements for each task. Yet preserved experience can be inappropriate for changed equipment or demands. Continuity is useful only when participants can question and revise it. This explains why the framework includes joint verification and renewed learning rather than treating institutional persistence as sufficient.

Interdependence places a boundary on the collective pathway. Where firms can adopt a technical solution independently, diffusion may support upgrading without joint capability. Where quality at one production stage depends on changes at another, separate adoption may leave a coordination problem unresolved. The distinction turns on the task, not the number of cooperating organisations. Nor does collective coordination prove upgrading: it may sustain an existing process, resolve a routine fault or maintain current standards. Evidence of more demanding production, improved quality or technological application must be examined separately from evidence of collaboration.

Governance of access and learning time

Knowledge sharing raises questions about permission and responsibility. General diagnostic methods may be suitable for joint learning while operating parameters remain commercially sensitive. A receiving firm needs to know what it may use and whom to consult when conditions differ. Participants also need to allocate trial costs, maintenance and responsibility for an unsuccessful test. The proposal is not complete openness, but access arrangements that make the relevant learning possible. Excessively closed relationships can exclude different knowledge, a risk consistent with Boschma's (2005) assessment of proximity.

Power matters within these arrangements. A lead firm may coordinate standards and tasks while smaller suppliers bear much of the adjustment cost. Colleges and less-resourced firms may not have equal influence over which problems receive support. The framework does not demonstrate that such asymmetries occur in every consortium; it identifies questions that a governance analysis should ask.

Who defines the shared task, who has access to guidance, and who can contest the decision to end support? Continued coordination can sustain exclusion as well as learning, so its distributional consequences need explicit scrutiny.

Learning time offers a second governance distinction. Delivery, initial use and sustained competence may occur at different moments. If a project ends at delivery, responsibility for continued learning can become unclear. Extending an agreement helps only when the unfinished task and a capable provider of guidance are identified. Xu et al. (2026) discuss timing differences in teaching reform; the present temporal proposition applies a related concern to the fit between learning and support periods, without claiming that their study tests this relationship.

Support decisions should therefore distinguish an unsuitable technical approach, unfinished learning and an unfulfilled obligation. Huo (2026), Zong (2026) and OECD (2020) already address feedback and governance. The contribution here is to connect a decision with the conversion that remains incomplete. Curriculum leaders can review teaching preparation; firms can reconsider task allocation; intermediaries can organise further verification. Public funding decisions remain with authorised agencies. The framework supplies questions for such decisions, not an established allocation formula.

Institutional setting and transfer across contexts

The Chinese setting makes the coordination problem visible through consortia and sectoral communities, but the proposed explanation is not tied to these institutional names. A connected supply chain may rely on a lead firm, while dispersed small firms may require an industry association, shared mentors or mobile educational services. Regional studies in Norway and Africa illustrate why institutional roles should be examined contextually (Lund and Karlsen, 2020; Wedekind et al., 2021). They do not demonstrate that any Chinese arrangement can be exported unchanged.

Colleges can contribute to technical problem-solving and return experience to learning materials, teacher development and continuing education. Shen and Sun's (2025) selected teaching innovation teams inform this connection, while Lewis (2025) places technician skills within technology deployment and incremental innovation. Equipment suppliers, internal training staff and technical advisers can also support use. A credible explanation of a college's contribution must distinguish its educational work from these alternative providers, rather than assume that it is always the central actor.

Demand translation remains an educational judgement. An employer's immediate request is information, not a complete curriculum. Colleges need to distinguish stable occupational knowledge from content that can be updated through short modules, projects and continuing education. Workplaces likewise need to provide meaningful participation rather than regard placement duration as learning. Studies of school-workplace connections and apprenticeship collaboration underline the importance of these arrangements within their particular systems (Sauli et al., 2021; James Relly and Laczik, 2022).

Who benefits from conversion

Regional productive outcomes and individual development need not coincide. Employee mobility can interrupt a firm's practice while improving the person's occupational prospects and carrying knowledge elsewhere. A regional partnership can help established employers yet offer little access to workers outside the network. The International Labour Organization (2004) links lifelong learning with employability, productivity and social inclusion. These concerns make it inappropriate to evaluate vocational education solely by the benefits retained within the training locality.

The framework consequently invites attention to who receives demanding tasks, who can access continuing education and whose knowledge can move between organisations. The proposed interventions should not restrict occupational choice or replace broader learning with a single employer's staffing needs. This is a limit on the instrumental interpretation of conversion, not evidence that a particular governance arrangement has already achieved equitable outcomes.

Limitations and future research

This article develops a theoretical explanation from selected published sources. It reports no original empirical data and does not establish causal effects. Source selection is not systematic, and the comparison cannot remove differences in study design, participants or spatial scale. It may underrepresent informal learning, disconnected labour markets and settings where colleges have little role in technical collaboration. The regional collective capability construct therefore remains open to revision.

The principal empirical challenge is to distinguish reused learning from repeated contact or contractual repetition. A future study would need to establish what earlier experience is mobilised, how it affects a subsequent interdependent task, and how new participants enter. A failed task need not establish the absence of capability, just as a successful task need not demonstrate its accumulation. Evidence about attempts, decisions, guidance and adaptation would need to accompany evidence about technical outcomes. Table 3 identifies prospective comparisons and contrary observations; none has been carried out for this article.

Table 3
Prospective comparisons and observations that could challenge the propositions

Proposition	Comparison to investigate	Contrary observation requiring explanation
P1 Use and organisational continuity	Comparable tasks and skill profiles with different use opportunities and team guidance	Continuity develops despite restricted use, or persists without the proposed learning arrangements
P2 Diffusion and collective continuity	Interdependent tasks with diffusion alone versus continuing joint verification and reuse	Later joint tasks proceed without earlier collaborative experience or continuing arrangements
P3 Learning time and support periods	Tasks requiring learning beyond delivery, with different access to follow-up guidance	Accumulation persists despite unfinished learning and no follow-up, or longer support adds no relevant learning

Note: Proposed observations for future investigation, not collected cases, validated indicators or completed tests. Task complexity, prior experience, supplier support, investment and alternative coordination arrangements would need to be examined before attributing differences to the proposed conditions.

Data availability

No original empirical datasets were generated or reanalysed. The conceptual argument draws on the publications and public policy document identified in the references. The theoretical comparison and prospective observation questions are included in the article tables.

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Regional attribution requires particular care. A network may cross administrative boundaries or connect firms that also rely on national suppliers and distant expertise. Its contribution to a locality cannot be inferred from addresses alone. Investment, market access, recruitment and supplier support may explain upgrading without regional joint action. Future research should compare these pathways instead of assuming that collective capability is an obligatory intermediary.

The temporal proposition also needs investigation. A longer support period may reflect a more difficult task rather than improve learning by itself. Comparisons must distinguish the complexity of work, participants' prior knowledge and actual access to guidance from the nominal contract duration. Distributional analysis should include workers and learners, not only managers and coordinating bodies. These prospective inquiries would test whether the distinctions help explain conversion and where their scope needs narrowing.

Conclusion

Vocational education's contribution to regional industrial upgrading cannot be inferred from skill supply, partnership formation or knowledge diffusion alone. The conceptual framework distinguishes capability formation, demand translation, capability use, and regional diffusion and accumulation, with feedback

throughout. It locates two transitions that require additional explanation: individual use becoming sustained organisational action, and circulation of knowledge becoming a continuing capacity for joint work.

Regional collective capability is proposed as the capacity to address interdependent tasks through relationships, rules and experience that remain usable in later collaboration. Use opportunities, team learning, joint verification and the fit between learning time and support periods condition the proposed transitions. Their effects remain untested. Collective capability may support technical adaptation and production coordination, but independent adoption can also enable upgrading, and joint action may merely sustain existing performance. The immediate implication is to identify what remains unfinished before selecting educational or governance support, while retaining learners' development and mobility as legitimate ends.

Declarations

Competing interests

The author declares no competing interests.

Ethical approval

Not applicable. This conceptual study did not recruit participants, collect personal data or reanalyse individual-level human data.

Informed consent

Not applicable. No participants were recruited and no identifiable participant information is reported.

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details have been withheld for double-anonymised review and will be supplied to the editorial office separately.

Author Contribution

Y.Z. was responsible for the conceptualisation and design of the study, development of the analytical framework, and manuscript preparation and revision. Y.Z. reviewed and approved the final manuscript and accepts responsibility for the accuracy and integrity of the work.

References

1. Becker GS (1964) Human capital: A theoretical and empirical analysis, with special reference to education. National Bureau of Economic Research
2. Billett S (2011) Vocational education: Purposes, traditions and prospects. Springer. https://doi.org/10.1007/978-94-007-1954-5
3. Boschma R (2005) Proximity and innovation: A critical assessment. Reg Stud 39(1):61–74. https://doi.org/10.1080/0034340052000320887
4. Central Committee of the Communist Party of China and State Council (2025) Jiaoyu qiangguo jianshe guihua gangyao (2024–2035 nian) (Education Powerhouse Development Plan for 2024–2035). In Chinese; English title translated. https://www.beijing.gov.cn/zhengce/gwywj/202501/t20250120_3992622.html Accessed 8 Oct 2026
5. Cohen WM, Levinthal DA (1990) Absorptive capacity: A new perspective on learning and innovation. Adm Sci Q 35(1):128–152. https://doi.org/10.2307/2393553
6. Finegold D (1999) Creating self-sustaining, high-skill ecosystems. Oxf Rev Econ Policy 15(1):60–81. https://doi.org/10.1093/oxrep/15.1.60
7. Florida R (1995) Toward the learning region. Futures 27(5):527–536. https://doi.org/10.1016/0016-3287(95)00021-N
8. Huo L (2026) Shipei yu jicheng: Goujian zhicheng gao zhiliang fazhan de chanjiao ronghe shengtai xitong (Adaptation and integration: Building an education-industry integration ecosystem to support high-quality development). Zhongguo Zhiye Jishu Jiaoyu (18):56–63, 100. In Chinese; English title translated.
9. International Labour Organization (2004) Human resources development recommendation, 2004 (No. 195). https://normlex.ilo.org/dyn/nrmlx_en/f?p=NORMLEXPUB:12100:0::NO::P12100_INSTRUMENT_ID:312533 Accessed 8 Oct 2026
10. Jaakkola E (2020) Designing conceptual articles: Four approaches. AMS Rev 10(1–2):18–26. https://doi.org/10.1007/s13162-020-00161-0
11. James Relly S, Laczik A (2022) Apprenticeship, employer engagement and vocational formation: A process of collaboration. J Educ Work 35(1):1–15. https://doi.org/10.1080/13639080.2021.1983524
12. Lewis P (2025) Innovation, technician skills, and vocational education and training: Connecting innovation systems and vocational education and training. J Vocat Educ Train 77(2):364–391. https://doi.org/10.1080/13636820.2023.2215749
13. Lund HB, Karlsen A (2020) The importance of vocational education institutions in manufacturing regions: Adding content to a broad definition of regional innovation systems. Ind Innovat 27(6):660–679. https://doi.org/10.1080/13662716.2019.1616534

14. McGrath S, Powell L (2016) Skills for sustainable development: Transforming vocational education and training beyond 2015. Int J Educational Dev 50:12–19. https://doi.org/10.1016/j.ijedudev.2016.05.006
15. OECD (2020) Strengthening the governance of skills systems: Lessons from six OECD countries. OECD Publishing. https://doi.org/10.1787/3a4bb6ea-en
16. OECD (2026) How workers use, or don't use, their skills in the workplace. OECD Publishing. https://doi.org/10.1787/0e7c6dc9-en
17. Sauli F, Wenger M, Berger JL (2021) Supporting apprentices' integration of school- and workplace-based learning in Swiss initial vocational education and training. Res Post-Compulsory Educ 26(4):387–409. https://doi.org/10.1080/13596748.2021.1980660
18. Shen Z, Sun D (2025) Zhiye yuanxiao jiaoshi jiaoxue chuangxin tuandui jianshe: Luoji, chengxiao yu weilai xiangdu - jiyu 32 ge tuandui de yanjiu (Building teaching innovation teams in vocational institutions: Logic, achievements and future directions based on a study of 32 teams). Zhiye Jishu Jiaoyu 46(2):54–60 In Chinese; English title translated
19. Wedekind V, Russon JA, Ramsarup P, Monk D, Metelerkamp L, McGrath S (2021) Conceptualising regional skills ecosystems: Reflections on four African cases. Int J Train Dev 25(4):347–362. https://doi.org/10.1111/ijtd.12251
20. Wen Y, Wu C, Shen Z (2026) Biaozhun zhuanyi yu leixing shengcheng - zhiye jiaoyu zhicheng chanye jiqun fazhan de jizhi yanjiu (Standard translation and type formation: Mechanisms through which vocational education supports industrial cluster development). Zhongguo Zhiye Jishu Jiaoyu (17):41–47. In Chinese; English title translated.
21. Xu S, Wang T, Rao Y (2026) Duochong zhidu luoji xia zhiye jiaoyu jiaoxue guanjian yaosu liandong gaige de shijian cuopei yu guanxi chonggou (Temporal mismatch and relational reconstruction in coordinated reform of key teaching elements in vocational education under multiple institutional logics). Zhongguo Zhiye Jishu Jiaoyu (9):5–12. In Chinese; English title translated.
22. Zhao J, Wang C, Zhang H (2026) Woguo zhiye jiaoyu chanjiao ronghe zhong de qiye ganzhi yu youhua celue - jiyu quanguo 3811 jia qiye de diaocha (Enterprise perceptions and strategies for improving education-industry integration in Chinese vocational education: A survey of 3811 enterprises). Zhiye Jishu Jiaoyu 47(9):56–63 In Chinese; English title translated
23. Zong C (2026) Shiyu chanjiao lianheti jianshe de xianshi yangtai yu youhua celue - jiyu 31 ge shiyu chanjiao lianheti de diaoyan fenxi (Current practices and improvement strategies in city-level education-industry consortia: An investigation of 31 consortia). Zhongguo Zhiye Jishu Jiaoyu (18):64–71. In Chinese; English title translated.