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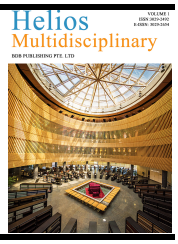

From Professional Development to Vocational Teaching Capability: A Self-Efficacy Narrative Review

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ABSTRACT

Professional development is routinely presented as the route by which vocational teachers keep pace with technological change, industry practice, and pedagogical reform. Yet participation is often treated as an outcome in itself, while the difficult passage from learning to changed teaching remains underexplained. This narrative review synthesises research on teacher professional development, teacher self-efficacy, vocational teacher competence, digital pedagogy, and school–workplace collaboration, with particular attention to higher vocational colleges in Guangdong, China. The review advances a dual-transfer thesis: professional development improves vocational teaching only when it helps teachers translate changing occupational practice into teachable curriculum and then translate professional learning into sustained classroom, laboratory, and workplace enactment. Teacher self-efficacy can assist this conversion by supporting effort, experimentation, and persistence, but it is neither a sufficient condition nor an inherently accurate indicator of capability. Its value depends on task specificity, mastery experience, credible feedback, collaborative sense-making, and organisational opportunity to act. This account reconciles the field's apparently conflicting evidence: positive effects are common for proximal self-report outcomes, whereas effects weaken when studies use independent observation, student learning, or causal designs. A dual-transfer and efficacy-calibration framework is proposed to shift evaluation from attendance and confidence towards demonstrated enactment and learner or industry evidence. The review concludes with a research agenda centred on longitudinal, multilevel, sector-sensitive, and practice-embedded designs.

1. Introduction

Vocational teachers work at a moving boundary. They must remain credible in occupations transformed by automation, artificial intelligence, green production, and new service models while also converting those changes into learning that students can understand, practise, and transfer. This is more than a requirement to know the latest technology. A teacher may understand an industrial process but be unable to sequence it pedagogically; may learn a new teaching strategy but lack the equipment, timetable, assessment authority, or workplace access needed to use it; or may feel increasingly confident without producing observable improvement. The central problem is therefore not whether professional development (PD) occurs, but whether learning crosses boundaries and becomes capability.

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This distinction is especially consequential in higher vocational education. VET teachers commonly hold a dual professional identity that spans an occupation and teaching, and the standards of competence in those two communities do not fully coincide (Antera, 2022, 2023). International policy consequently emphasises teachers' continuing contact with industry, pedagogical expertise, and digital competence rather than a single, static qualification (OECD, 2021; UNESCO, 2022). In China, the 2021–2025 national quality-improvement plan and the standards for recognising "dual-qualified" teachers likewise connect teacher development with industry practice, educational capacity, and institutional reform (Ministry of Education of the People's Republic of China, 2022; Ministry of Education of the People's Republic of China & Ministry of Finance of the People's Republic of China, 2021). Guangdong is a particularly revealing context because a technologically dynamic economy places persistent pressure on colleges to renew curricula and because the province has invested in teacher-training and enterprise-practice bases (People's Government of Guangdong Province, 2021).

The literature offers a reassuring headline but a less reassuring foundation. Reviews and meta-analyses show that PD can improve teaching, student outcomes, and teacher self-efficacy, particularly when it contains subject-specific practice, coaching, feedback, and follow-up (Kraft et al., 2018; Popova et al., 2022; Täschner et al., 2025; Zhou et al., 2023). However, "effective-feature" lists can overstate what correlational designs permit researchers to infer, and programmes typically available at scale often differ from the intensively supported interventions that generated the strongest effects (Asterhan & Lefstein, 2024; Lindvall et al., 2025). A parallel difficulty concerns self-efficacy. It predicts persistence and is associated with instructional quality in many studies, yet its relationship with independently observed teaching and student achievement is weaker and less consistent than its relationship with teachers' own reports (Jerrim et al., 2023, 2025; Zee & Koomen, 2016).

This review's thesis is that PD should be understood as a dual-transfer system rather than an educational dose. First, occupational and technological change must be translated into teachable curriculum, assessment, and learning tasks. Second, ideas encountered in PD must be translated into sustained classroom, workshop, laboratory, and workplace practice. Teacher self-efficacy is proposed as an evidence-calibrated conversion mechanism within these transfers: it can mobilise effort and experimentation, but only when it is built through authentic mastery, checked against credible external evidence, and supported by institutional conditions. This thesis replaces a simple chain—more PD, greater efficacy, better teaching—with a conditional and reciprocal account.

The review has three purposes. It traces how thinking about PD has moved from participation and generic programme features towards situated enactment; critically synthesises why studies reach conflicting conclusions about PD, self-efficacy, and teaching effectiveness; and develops a practical research agenda for higher vocational colleges in Guangdong. Its contribution is not another universal checklist. It is a framework for asking where transfer breaks, how confidence is calibrated, and what evidence would demonstrate that professional learning has become vocational teaching capability.

2. Materials and Methods

2.1 Narrative review approach

A narrative review was selected because the focal problem crosses literatures that use different constructs, outcomes, and research designs. The task was interpretive integration rather than estimation of a single common effect. Reporting was guided by the Scale for the Assessment of Narrative Review Articles, particularly its expectations for explicit aims, transparent searching, reasoned evidence selection, scientific reasoning, and relevant endpoint data (Baethge et al., 2019).

The review does not claim the exhaustive coverage or reproducible study selection of a systematic review.

Searches were conducted and updated through 31 August 2026 using multidisciplinary scholarly discovery and citation tools, including SciSpace, Consensus, and Sider Scholar, supplemented by publisher pages, DOI records, and the official websites of OECD, UNESCO, China's Ministry of Education, and the People's Government of Guangdong Province. Search combinations covered "teacher professional development," "teacher self-efficacy," "teaching effectiveness," "vocational teacher," "technical and vocational education and training," "school–industry collaboration," "digital competence," "double-qualified teacher," "higher vocational college," "China," and "Guangdong." Backward and forward citation tracing connected recent reviews with foundational theory and influential empirical work.

2.2 Selection, weighting, and synthesis

Priority was given to peer-reviewed meta-analyses, systematic or critical reviews, longitudinal studies, causal or quasi-experimental evaluations, and major international or official Chinese policy sources. Seminal conceptual studies were retained when needed to define self-efficacy or explain the development of PD theory. Evidence was included when it illuminated at least one link among programme architecture, teacher learning, efficacy, enactment, or learner and industry outcomes. Studies focused only on initial teacher preparation were used selectively, because their learning conditions may differ from those of employed vocational teachers. Unpublished plans, vendor claims, and references whose bibliographic identity or relevance could not be verified were excluded.

Evidence was interpreted according to design strength, outcome proximity, setting, and transfer conditions rather than citation count alone. A study measuring post-course satisfaction was not treated as equivalent to one using independent classroom observation or student outcomes. Likewise, evidence from general schooling informed mechanisms but was not assumed to transfer unchanged to occupationally specialised higher vocational settings. Table 1 summarises this weighting logic.

Table 1

Evidence domains and their role in the narrative synthesis

Evidence domain	Priority evidence	Question answered	Main interpretive caution
PD effectiveness	Meta-analyses, causal evaluations, critical reviews	Under what conditions does PD change instruction or learning?	Intensive research trials may not resemble routine, at-scale provision
Teacher self-efficacy	Intervention reviews, longitudinal studies, independent observations	Does efficacy enable enactment, reflect it, or both?	Self-report measures may share method variance with self-reported teaching
Vocational teacher competence	VET studies, school–workplace research, international policy	What is distinctive about occupationally situated teaching?	National VET systems and occupational sectors differ substantially
Digital and technological change	Competence frameworks and empirical profiles	What knowledge must be integrated when tools and work processes change?	Tool confidence is not the same as pedagogically sound use
Guangdong and China	Official standards, implementation policies, contextual studies	What institutional structures shape transfer locally?	Policy intent does not demonstrate implementation quality or impact

Note. The hierarchy informed interpretation, not mechanical exclusion. Convergence across different designs and contexts was treated as stronger than a single statistically significant association.

The synthesis proceeded in three passes. The first mapped the historical movement from attendance to programme design and then to implementation systems. The second compared supportive, null, and contradictory findings, looking for differences in samples, measures, timing, and opportunity to enact learning. The third used vocational boundary work as a lens through which to integrate these findings and construct the dual-transfer and efficacy-calibration framework.

3. Results: Why Vocational Teaching Makes Transfer Difficult

3.1 One occupation, two regimes of competence

Antera (2023) further shows that formal teaching qualification and occupational experience produce different competence profiles, reinforcing the need to examine rather than assume their integration.

Generic accounts of teacher learning often assume that the content to be taught is relatively stable and that the main challenge is pedagogical improvement. Vocational teaching disrupts that assumption. Teachers must maintain occupational credibility while acquiring the ability to select, represent, scaffold, and assess occupational knowledge. Interview and survey research with vocational teachers describes this as movement between two regimes of competence: what counts as expert performance in the workplace is related to, but different from, what counts as effective teaching (Antera, 2022, 2023). The distinction matters because programmes can strengthen one regime while neglecting the other. An industry placement may renew technical knowledge without helping a teacher transform tacit expertise into curriculum; a pedagogy course may improve lesson design while remaining detached from authentic occupational tasks.

School–workplace collaboration offers a potential bridge, but proximity alone is insufficient. Hiim's (2023) action-research synthesis found that relevance grew when schools and enterprises organised collaboration around core vocational tasks, shared expectations, regular dialogue, joint planning, and follow-up. The implication is that industry participation works through structured boundary activity, not through the symbolic presence of an enterprise partner. This helps explain why apparently similar "industry-linked" programmes can yield different results: the active ingredient may be joint curriculum work and feedback on authentic performance, not the partnership label.

This first transfer—from occupational practice to teachable curriculum—is also sector-sensitive. The rate and form of change differ among advanced manufacturing, logistics, health care, hospitality, digital media, and business services. A province-wide programme can therefore be coherent administratively but thin instructionally. Occupational specificity is not a minor implementation detail; it determines whether teachers encounter knowledge they can convert into meaningful tasks for their students.

3.2 Technology increases the translation burden

Digitalisation compounds the boundary problem. The professional demand is not merely to operate a tool but to judge when, why, and under what constraints it should be used for learning. Falloon's (2020) teacher digital competency framework accordingly combines technical skill with pedagogy, ethics, professional engagement, and context. Research on vocational teacher preparation similarly suggests that digital competence is multidisciplinary and uneven rather than a single trait (Roll & Ifenthaler, 2021). These findings challenge PD organised as brief demonstrations of fashionable platforms. Operational familiarity may increase rapidly, while the capacity to

redesign an assessment, simulate an unsafe process responsibly, protect data, or preserve hands-on judgement develops more slowly (Wu et al., 2026; Zhao et al., 2025).

Evidence from emergency online teaching reinforces this distinction. Readiness profiles in higher education varied substantially, and confidence, prior experience, support, and pedagogical beliefs formed different constellations rather than one linear readiness scale (Scherer et al., 2021). In vocational colleges, where many outcomes require embodied performance, equipment, teamwork, and safety judgement, the risk of confusing digital activity with educational improvement is particularly high. Effective PD must connect the technology to an occupational problem and provide opportunities to test whether the redesigned task produces better evidence of student capability.

3.3 The Guangdong policy opportunity—and implementation risk

China's policy architecture recognises many elements of this problem. National plans call for stronger teacher teams, enterprise practice, pedagogical innovation, and the development of "dual-qualified" teachers (Ministry of Education of the People's Republic of China, 2022; Ministry of Education of the People's Republic of China & Ministry of Finance of the People's Republic of China, 2021). Guangdong's training and enterprise-practice bases create infrastructure for connecting colleges with a diverse regional economy (People's Government of Guangdong Province, 2021). These structures provide an unusual opportunity to treat PD as a regional learning system.

The same architecture also creates a measurement risk. When hours completed, certificates earned, bases established, or recognition status become dominant indicators, visible activity can substitute for transfer. Policy inputs are necessary, but they do not reveal whether occupational knowledge was converted into curriculum, whether teachers rehearsed new practice, whether students encountered better tasks, or whether industry partners judged graduates' performance differently. A narrative centred on self-efficacy is useful only if efficacy is positioned between these inputs and observable enactment, not used as another convenient post-course score.

4. Results: From Participation Frequency to PD Architecture

4.1 Why frequency is an incomplete explanation

Early and still-common evaluation models treat participation frequency, contact hours, or duration as exposure variables. Duration can matter because complex practice requires time, but time has no stable meaning apart from what teachers do during it. Ten hours of passive presentation and ten hours of coached rehearsal are not comparable doses. Desimone's (2009) influential framework redirected attention towards content focus, active learning, coherence, duration, and collective participation, building on large-scale evidence that structural and core features shape teacher learning (Garet et al., 2001). This was an important advance: programme quality became analysable rather than assumed.

Subsequent research refined—and complicated—that consensus. Reviews commonly associate effective PD with subject focus, modelling, practice, feedback, collaboration, coaching, and sustained support (Darling-Hammond et al., 2017; Kraft et al., 2018). Global evidence also indicates a gap between strong evaluated programmes and routine provision: at-scale programmes are less likely to include practice, career relevance, materials, mentoring, or follow-up (Popova et al., 2022). Online PD can be valuable when it combines relevance, practical activity, reflection, support, and interaction, but the underlying studies remain heterogeneous and often methodologically weak (Bragg et al., 2021).

The tempting conclusion is to assemble a universal list of effective features. Asterhan and Lefstein (2024) show why this inference is unsafe. Features frequently co-occur, are defined inconsistently, and are often inferred from studies not designed to isolate their causal contribution.

A recent review of the PD teachers typically receive reached a similarly cautious conclusion: only a small share of studies supported causal inference, associations with instruction were more positive than effects on student achievement, and stronger quasi-experimental estimates were often small or null (Lindvall et al., 2025). The field therefore needs theories of mechanism and implementation, not only better checklists.

4.2 From features to learning mechanisms

Features become meaningful when linked to what teachers must learn. Modelling can make an invisible decision process visible. Rehearsal can reveal whether a teacher can adapt an idea under authentic constraints. Feedback can correct an error before it becomes routine. Collaboration can expose conflicting interpretations and distribute design work. Coaching can sustain repeated cycles of enactment. Duration matters when these cycles require time. Seen this way, no feature is independently effective; its contribution depends on the learning problem and the quality of enactment.

The evidence supports this mechanism-oriented interpretation. Teacher coaching has stronger average effects on instruction than on achievement and shows implementation challenges at scale (Kraft et al., 2018). Data-based decision-making PD shows a positive average effect but substantial heterogeneity and limited generalisability from researcher-supported conditions (Gesel et al., 2021). Kennedy (2016) similarly argues that PD effects depend on how programmes address persistent problems of practice and how prescriptions interact with teachers' existing ways of thinking. Opfer and Pedder's (2011) complexity perspective locates teacher learning in interactions among the individual, the school, and the learning activity. Together, these studies move the unit of analysis from the workshop to the learning-and-enactment system.

Table 2

Professional-development mechanisms, evidence tensions, and vocational implications

Mechanism	Plausible contribution	Why findings conflict	Implication for higher vocational colleges
Occupational content focus	Renews technical knowledge and curriculum relevance	Content may be current but tacit, overly general, or detached from student tasks	Organise around authentic occupational tasks and convert them into teachable sequences and assessments
Modelling and rehearsal	Makes practice visible and permits low-risk experimentation	Demonstration quality, authenticity, and rehearsal time vary	Use workshops, laboratories, simulations, and microteaching with sector-specific constraints
Feedback and coaching	Calibrates judgement and sustains refinement	Research-supported coaching can be costly and difficult to scale	Develop trained peer or industry coaches and specify observable feedback criteria
Teacher collaboration	Supports shared design and collective problem-solving	Meetings may be administrative or reinforce existing assumptions	Give teams protected time, student evidence, and a concrete curriculum product to improve
Enterprise engagement	Updates occupational practice and strengthens relevance	Partnership labels conceal variation in reciprocity, task quality, and follow-up	Co-design tasks, assessment criteria, placements, and post-placement curriculum revisions
Digital learning	Extends access, flexibility, and simulation possibilities	Platform use may be mistaken for pedagogical integration	Evaluate the occupational and learning problem solved, not tool adoption alone
Duration and frequency	Allow repeated learning and practice cycles	Time can contain passive attendance or	Count completed enactment-and-feedback cycles rather than

Mechanism	Plausible contribution	Why findings conflict	Implication for higher vocational colleges
		purposeful iteration	contact hours alone

Note. Mechanisms are conditional; no row should be interpreted as a universal component checklist (Asterhan & Lefstein, 2024; Kennedy, 2016; Lindvall et al., 2025).

4.3 Collaboration as designed work, not collegial atmosphere

Teacher collaboration deserves particular scrutiny because it appears both in general PD frameworks and VET policy. Collective participation can align language, curriculum, and expectations, but collaboration is not intrinsically developmental. It can preserve familiar routines, diffuse responsibility, or consume time without changing a task. Its value increases when teachers jointly examine concrete artefacts—student work, observation records, assessment rubrics, workplace feedback, or curriculum prototypes—and when disagreement is used diagnostically.

For vocational colleges, collaboration must often cross institutional boundaries. The productive unit is not simply a teacher team but a configuration of teacher, occupational expert, pedagogical coach, and sometimes student. Hiim (2023) shows that regular, task-centred dialogue and shared planning create coherence between learning arenas. The design implication is precise: collaboration should produce and test a boundary object, such as a revised work task, simulation, rubric, or placement protocol. Without that product and an evidence loop, “teacher collaboration” remains too vague to explain effectiveness.

5. Results: Teacher Self-Efficacy as a Calibrated Conversion Mechanism

5.1 What self-efficacy can explain

Teacher self-efficacy refers to a teacher’s judgement of capability to organise and execute actions required for a particular teaching task, not a general sense of worth or optimism (Bandura, 1997; Tschannen-Moran et al., 1998). It is shaped through mastery experience, vicarious experience, social persuasion, and interpretations of physiological or emotional states. The construct is therefore well positioned to explain why two teachers who learn the same strategy may enact it differently. A teacher who believes a new approach is manageable is more likely to attempt it, persist through difficulty, and adapt after an imperfect first trial.

Measurement research nevertheless warns against treating efficacy as a context-free trait. Teachers distinguish efficacy for instructional strategies, classroom management, and student engagement, and their judgements are sensitive to task and setting (Tschannen-Moran & Hoy, 2001). In vocational education, the relevant domains may include demonstrating a process safely, integrating workplace standards, assessing practical competence, teaching with unfamiliar equipment, coordinating workplace learning, or redesigning instruction with digital tools. A global score can conceal a teacher who feels confident pedagogically but uncertain occupationally, or the reverse.

Intervention evidence confirms that efficacy is modifiable. A meta-analysis of 115 studies found a moderate positive average effect of interventions on teacher self-efficacy, with reflective and mastery-related elements particularly important (Täschner et al., 2025). A STEM-focused meta-analysis likewise found a moderate effect of PD on self-efficacy (Zhou et al., 2023). These results justify locating efficacy within the transfer process, but they do not establish that efficacy mediates effects on independently measured teaching or learners. Most interventions were not designed to test the entire causal chain, and many measured efficacy immediately after the programme.

5.2 The calibration problem

The strongest challenge to a simple mediation story is the difference between subjective and external outcomes. Teacher efficacy is consistently associated with teacher-reported instruction, wellbeing, commitment, and classroom processes, but longitudinal and meta-analytic relationships with student achievement are generally smaller and heterogeneous (Klassen & Tze, 2014; Zee & Koomen, 2016). Jerrim et al. (2023) argue that the association with pupil achievement may be much weaker than widely assumed. Using video evidence, Jerrim et al. (2025) found strong relationships between efficacy and teachers' own ratings of lesson quality but little association with expert ratings or student outcomes. This pattern is not proof that efficacy is irrelevant; it is evidence that shared method, optimistic self-appraisal, and outcome distance matter.

A better model treats efficacy as needing calibration. Well-calibrated efficacy is confidence adjusted through authentic attempts and credible information about performance. Underconfidence can prevent capable teachers from experimenting. Overconfidence can reduce help-seeking and conceal weak practice. Accurate confidence supports appropriately ambitious action, interpretation of setbacks, and targeted learning. Mastery experience is therefore most useful when the "mastery" is not merely completing a course but successfully enacting a task under meaningful constraints.

Longitudinal evidence also suggests reciprocity. Teaching quality can strengthen efficacy just as efficacy can support teaching quality; successful lessons generate mastery information for the next judgement (Holzberger et al., 2013). Sources of efficacy operate through interpretation, and feedback is not automatically accepted or useful (Morris et al., 2017). The mechanism is thus a loop: judgement shapes action, action produces evidence, and evidence revises judgement. PD improves the loop when it supplies attainable challenges, models, coached practice, external feedback, and opportunities to retry.

5.3 From generic confidence to task-specific professional judgement

For vocational teachers, task specificity must cross both competence regimes. Consider a teacher learning computer-aided manufacturing. Technical self-efficacy concerns operating and troubleshooting the system; teaching self-efficacy concerns representing concepts, anticipating misconceptions, managing safe practice, and assessing performance; transfer efficacy concerns adapting the lesson to available equipment and student readiness. A single generic efficacy score cannot distinguish these judgements.

This matters for programme evaluation. A post-course rise in confidence may reflect familiarity with terminology or enthusiasm generated by the facilitator. A more persuasive chain would show that teachers redesigned an authentic task, rehearsed it, received feedback from pedagogical and occupational experts, implemented it with students, and adjusted it in response to observed performance. Efficacy measured at several points could then be interpreted alongside enactment. In that design, efficacy is neither dismissed as "only subjective" nor accepted as proof of effectiveness; it becomes diagnostic evidence about where transfer may succeed or fail.

6. Critical Synthesis: Reconciling Positive and Null Findings

The literature's disagreements become more intelligible when studies are arranged by the distance between intervention and outcome. PD commonly improves satisfaction, perceived knowledge, or efficacy because these are proximal to participation. Changes in reported practice are more demanding. Changes in independently observed practice require enactment under workplace constraints. Student learning and employment-relevant performance are still more distal and depend on attendance, curriculum alignment, resources, prior learning, and many other influences. Diminishing effects across this chain are not necessarily contradictory; they reveal cumulative transfer loss (Wang & Pan, 2022).

Six recurrent sources of apparent conflict can be identified. First, studies use different outcomes but discuss all of them as "effectiveness." Confidence and student competence are not interchangeable. Second, self-report designs create shared-method associations, whereas observation and administrative outcomes impose a stronger test. Third, participants self-select into many PD programmes, so motivation and prior capability may account for part of the association. Fourth, implementation support varies: a researcher-developed programme with coaching, materials, and fidelity checks is not equivalent to routine provision. Fifth, effects depend on task, subject, and occupational sector. Sixth, timing matters: immediate confidence can precede an implementation dip, while durable change may require repeated cycles.

These distinctions also clarify why frequency, quality, technology integration, and collaboration should not be modelled as parallel, independent inputs. Frequency has value only when it supplies enough cycles for learning and revision. Quality is not a global programme rating but the alignment of mechanisms with a problem of practice. Technology integration is both content and context: it changes what is taught and how it can be taught. Collaboration is a delivery structure that can activate modelling, feedback, and collective design. Their effects overlap and interact.

The mediation proposition therefore needs qualification. A credible pathway is not PD participation → higher efficacy → teaching effectiveness. It is a conditional sequence in which relevant PD creates supported mastery opportunities; those opportunities revise task-specific efficacy and professional judgement; teachers enact and adapt practice; student, colleague, and industry evidence recalibrates judgement; and the institution provides time, equipment, leadership, curriculum authority, and partnership access. If any link is missing, efficacy may rise without capability, or capability may improve without being captured by a generic efficacy measure.

This interpretation aligns with Mezirow's (1997) account of transformative learning only when reflection is connected to action and examination of assumptions. Transformative language is sometimes used too loosely in PD discourse, as though a powerful workshop experience were itself transformation. In vocational teaching, perspective change becomes educationally consequential when it alters task design, interaction, assessment, or boundary relations and survives organisational constraints. Critical reflection is therefore one mechanism within transfer, not an endpoint.

7. Discussion: A Dual-Transfer and Efficacy-Calibration Framework

Figure 1 integrates the synthesis. External pressures—including changes in occupations, technology, policy, and learner needs—enter a PD architecture organised around relevant content, authentic rehearsal, industry immersion, collaboration, feedback, and follow-up. The first transfer converts occupational change into teachable curriculum and assessment. The second converts professional learning into enacted practice. Between and across them, task-specific efficacy and professional judgement influence what teachers attempt, how they interpret difficulty, and whether they persist. Organisational transfer conditions shape both passages. Evidence from students, peers, and industry closes the loop by calibrating judgement and directing the next learning cycle.

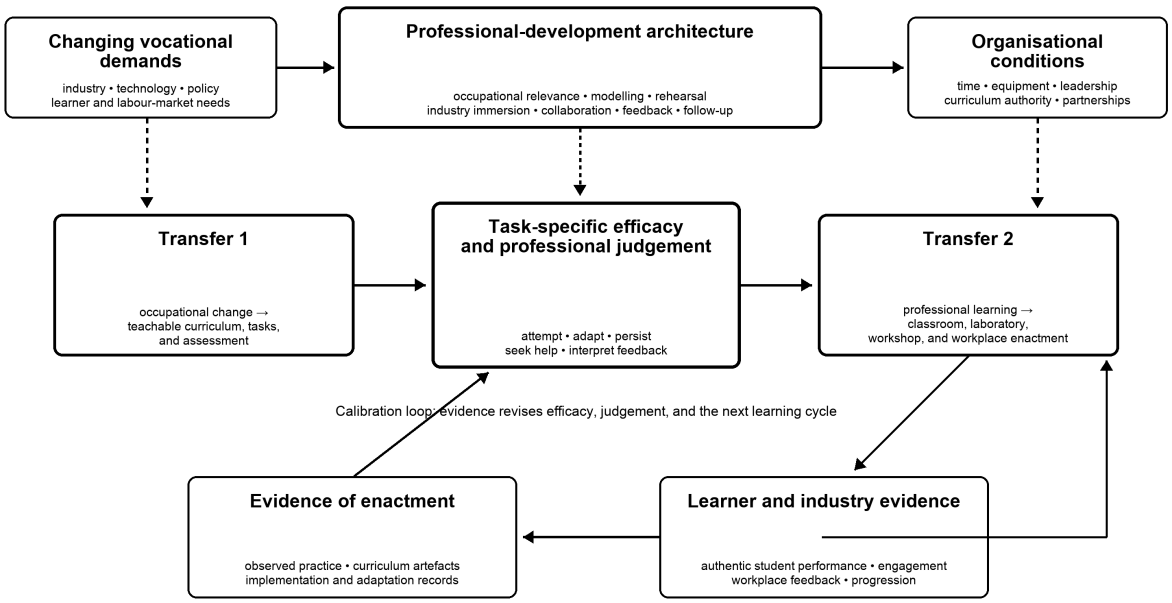

Figure 1. Dual-transfer and efficacy-calibration framework for vocational teacher professional development

The framework makes three analytical advances. First, it separates occupational updating from pedagogical enactment. A programme can succeed at one and fail at the other. Second, it treats efficacy as reciprocal and evidence-sensitive rather than a one-way mediator. Third, it places institutional conditions inside the causal explanation. Time, equipment, leadership, curriculum authority, and enterprise relationships are not background variables; they determine whether a teacher can convert intention into action.

For Guangdong, the framework implies a shift from counting participation to documenting transfer. Teacher-development bases could require portfolios showing how an industry or technological change was converted into a curriculum task, piloted, observed, and revised. Enterprise-practice bases could pair workplace immersion with structured pedagogical debriefing and joint assessment design. Teaching innovation teams could use common evidence protocols rather than relying on informal impressions. Digital PD could begin with a learning or occupational problem and end with evidence that the tool improved access, authenticity, feedback, safety, or assessment validity.

Evaluation should use a linked set of indicators. Inputs include access, time, and programme architecture. Immediate learning includes knowledge, skill, and task-specific efficacy. Transfer indicators include redesigned artefacts, observed enactment, and fidelity or adaptation records. Outcomes include student performance on authentic tasks, engagement, progression, and where appropriate feedback from workplace supervisors. Equity indicators should examine whether teachers in rural colleges, less-resourced institutions, or rapidly changing sectors receive comparable opportunity and support. Costs and workload should also be recorded because an effective model that cannot be sustained is not an effective system at scale (Pan, Xu, et al., 2026; Pan, Zou, et al., 2026).

8. Research Gaps and Future Directions

The first gap is causal and temporal. Cross-sectional questionnaires can estimate associations among PD, efficacy, and teaching effectiveness but cannot establish ordering, distinguish selection from impact, or capture reciprocal change. Studies should measure efficacy before PD, after supported rehearsal, during initial enactment, and after feedback, alongside observation and student evidence. Longitudinal cross-lagged or latent-change models can test reciprocity;

randomised, stepped-wedge, regression-discontinuity, or strong matched designs can improve causal inference when random assignment is impractical.

The second gap is construct validity. Researchers should replace generic "PD quality" and "technology integration" scales with indicators of specific mechanisms and tasks. Vocational teacher efficacy instruments need domain definition, cognitive interviewing, measurement invariance testing across sectors, and comparison with observed performance. Mediation should be tested with temporally separated measures and confidence intervals for indirect effects, not inferred because two pairwise associations are significant.

The third gap is multilevel transfer. Teachers are nested in departments and colleges, while partnerships connect colleges with enterprises and regional systems. Future research should measure leadership, protected time, equipment, team learning, curriculum authority, coach quality, and enterprise reciprocity. Multilevel models can then ask whether an apparently weak individual effect becomes stronger in supportive settings or whether high efficacy compensates for constraints only temporarily.

The fourth gap is vocational and geographic specificity. Evidence from compulsory schooling or general higher education cannot answer how mechanisms operate in nursing laboratories, intelligent manufacturing workshops, logistics simulations, hospitality placements, or digital design studios. Guangdong studies should sample across the Pearl River Delta and eastern, western, and northern parts of the province; include public and private colleges; and report occupational sector, teacher background, industry recency, and resource conditions. Comparative case studies can identify which elements transfer and which require local redesign.

The fifth gap concerns external criteria. Much of the literature relies on teacher perception. Studies should incorporate blinded observation where feasible, common performance tasks, student work, practical assessment, and structured industry feedback. Qualitative process data remain essential because they show how teachers interpret PD and adapt it, but triangulation should be designed from the outset rather than added to validate a preferred conclusion.

The sixth gap is the changing content of vocational capability. AI, data-intensive production, green technologies, and hybrid learning create new requirements and new risks. Research should compare technology-operation training with programmes that integrate occupational content, pedagogy, ethics, safety, and assessment. It should also test for adverse effects: automation bias, loss of hands-on practice, privacy problems, excessive workload, and inflated confidence.

Table 3

Priority research agenda for professional development in Guangdong higher vocational colleges

Priority question	Recommended design	Minimum evidence set	Decision value
Does efficacy mediate transfer, reflect successful enactment, or both?	Four-wave longitudinal study with cross-lagged and mediation analysis	Task-specific efficacy, observed teaching, curriculum artefacts, student performance	Clarifies temporal ordering and avoids one-way mediation assumptions
Which PD mechanisms work for which occupational tasks?	Multisite factorial, stepped-wedge, or realist-informed comparative study	Implementation records, sector and task characteristics, coaching and collaboration exposure	Replaces generic feature lists with mechanism–context explanations
Does enterprise engagement improve curriculum relevance?	Comparative partnership study with process tracing	Jointly designed tasks, placement records, teacher and industry assessments, student work	Distinguishes reciprocal partnerships from symbolic participation

Priority question	Recommended design	Minimum evidence set	Decision value
Can effective programmes scale without losing support quality?	Scale-up study with cost and fidelity analysis	Reach, dosage, coach quality, adaptations, workload, costs, outcomes	Tests feasibility beyond researcher-supported conditions
Are benefits equitable across regions and institutions?	Stratified provincial cohort and multilevel analysis	Geography, institution type, resources, teacher access, transfer indicators	Reveals whether infrastructure reduces or reproduces opportunity gaps
How should AI and digital tools enter vocational PD?	Task-based trials with safety and ethics evaluation	Pedagogical rationale, authentic performance, access, privacy, workload, error patterns	Separates purposeful integration from adoption for its own sake

Note. All designs should predefine primary outcomes, report implementation and attrition, and separate teacher-reported practice from independently assessed enactment.

9. Conclusion

The most useful question for vocational teacher development is not how much PD teachers receive, but what must cross which boundary for teaching to improve. The evidence supports a dual-transfer answer. Occupational change must first become teachable curriculum, and professional learning must then become sustained enactment. Programme relevance, rehearsal, feedback, collaboration, coaching, industry engagement, and follow-up matter because they can enable these transfers, not because they form a universally effective checklist.

Teacher self-efficacy belongs inside this account, but in a more disciplined role than is often assigned to it. It can mobilise effort, experimentation, and persistence; it can also be miscalibrated, share method variance with reported teaching, and fail to predict independently observed quality or student outcomes. The appropriate aim is therefore evidence-calibrated efficacy: confidence built through authentic mastery, checked against credible feedback, and revised through repeated enactment.

For higher vocational colleges in Guangdong, this perspective converts existing policy infrastructure into a sharper improvement strategy. Training and enterprise-practice bases should be evaluated through the curriculum products, teaching performances, and learner or industry evidence they generate. Research should follow the transfer process over time, across institutional levels, and within particular occupational sectors. When participation is treated as the beginning rather than the result of professional development, the field can move from reporting teacher activity to explaining vocational teaching capability.

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