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Towards a vocational education ecosystem framework: A systematic literature review of industry partnership, curriculum alignment, educational financing, and employability in SMK and TVET

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Abstract

Background: Vocational education and training (SMK and TVET) are expected to reduce skills mismatch and improve employability. However, many reforms remain fragmented because industry partnership, curriculum alignment, educational financing, and employability are often treated as separate issues rather than interconnected dimensions within a vocational education ecosystem.
Aims: This study aims to develop a Vocational Education Ecosystem Framework (VEEF) explaining how industry partnership, curriculum alignment, educational financing, and employability interact systematically in SMK and TVET.
Methods: The study employs a Systematic Literature Review (SLR) with a critical-interpretive synthesis orientation. Scopus-indexed journal articles published between 2021–2026 were identified, screened, and synthesised using PRISMA procedures, explicit selection criteria, and thematic analysis**.**
Results: The findings show that industry partnership functions as a governance mechanism connecting institutions, firms, and labour markets. Curriculum alignment acts as a translational mechanism linking labour-market needs with pedagogy, assessment, certification, and teacher capability. Educational financing serves as enabling infrastructure supporting implementation quality, innovation, access, and sustainability. Employability emerges as a systemic outcome shaped by the interaction among governance, curriculum, and resource configuration. These relationships form the basis of VEEF, consisting of Governance, Translational, Resource, and Outcome nodes.
Conclusion: Effective SMK and TVET systems depend on strong ecosystem integration rather than isolated interventions. VEEF offers a comprehensive conceptual foundation for understanding vocational education reform and sustainable school-to-work transitions.

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INTRODUCTION

Vocational education and training (SMK and TVET) increasingly occupies a strategic position in responding to youth unemployment, industrial transformation, technological change, and the growing demand for a work-ready labour force (Yasdin & Muksins, 2024). In many countries, governments continue to expand vocational pathways through various "link and match" policies intended to strengthen school-to-work transitions and improve graduate employability (Jin et al., 2025). Despite these efforts, however, many vocational graduates still face unemployment, underemployment, skills mismatch, and difficulties entering decent work (Barford et al., 2021; Pawar & Babacan, 2025). Such conditions suggest that vocational education reforms often appear successful at the policy level but do not always produce consistent labour-market outcomes in practice. The challenge becomes more complex in developing-country contexts, where vocational systems

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frequently operate within uneven institutional capacity, limited industry participation, regional disparities, and constrained educational resources (Allais, 2022). In many cases, reform agendas focus mainly on curriculum redesign or employability targets without sufficiently strengthening governance structures, financing systems, and institutional coordination (Wolff et al., 2025). As a result, the effectiveness of SMK and TVET is shaped not only by student competencies, but also by how educational institutions, industries, labour markets, and policy environments interact with one another (Abd Rahman et al., 2025). Taken together, these conditions indicate that vocational education needs to be understood through a broader ecosystem perspective rather than through isolated institutional factors alone.

Previous studies have approached vocational education from several theoretical and policy perspectives. Human capital theory explains vocational education as an investment that enhances productivity and employability through skill formation (Leoni, 2025; Sairmaly, 2023). In contrast, job competition theory emphasises labour-market competition, signalling processes, and the positional value of educational qualifications (Suleman, 2021). More recent discussions increasingly adopt systemic and relational perspectives through the concept of the skills ecosystem, which highlights the interconnected roles of educational institutions, firms, governments, intermediary actors, and labour markets in shaping workforce transitions. Within this broader discussion, industry partnership is widely recognised as an important mechanism for improving curriculum relevance, workplace exposure, and employability outcomes (Kebede et al., 2024; Scandurra et al., 2024). Studies frequently emphasise apprenticeships, work-based learning, teaching factories, and public–private partnerships as ways to strengthen vocational learning experiences and labour-market responsiveness (Brockmann & Smith, 2023). At the same time, curriculum alignment has become a major concern, particularly regarding the integration of industry needs, digital competencies, problem-solving abilities, and adaptive skills into pedagogy, assessment, and certification systems. Another growing area of discussion concerns educational financing. Existing studies show that financing influences infrastructure quality, teacher development, workplace learning opportunities, innovation capacity, and equitable access to vocational education (Mack, 2024; Okoye et al., 2025). Employability is also increasingly viewed as a multidimensional outcome shaped not only by technical competence, but also by soft skills, digital capability, adaptability, and institutional support. Collectively, these studies suggest that vocational education outcomes emerge from the interaction among governance, curriculum, financing, and labour-market processes (Marczuk, 2024).

Although previous studies have contributed important insights to vocational education research, the literature remains fragmented (Weijzen et al., 2024). Most studies examine industry partnership, curriculum alignment, financing, or employability separately rather than explaining how these dimensions interact systematically within a vocational education ecosystem (Zhou & Deng, 2025). In particular, educational financing is often positioned merely as a supporting factor, despite its strong influence on implementation quality, institutional sustainability, innovation capacity, and equitable access within SMK and TVET systems. In addition, many existing approaches still rely on linear assumptions that curriculum reform or industry collaboration alone will automatically improve employability outcomes (Olo et al., 2021). Such perspectives make it difficult to explain why similar vocational reforms often produce different results across institutional and national contexts. Consequently, there remains limited conceptual understanding of how governance, curriculum translation, financing, and employability operate reciprocally within vocational education systems.

limitations, vocational education outcomes cannot be adequately understood through isolated variables or single-policy approaches. Employability and school-to-work transitions emerge from reciprocal interactions among industry partnership, curriculum alignment, educational financing, and institutional coordination (Neriyanuri, 2024). From this perspective, vocational education

should be viewed as an interconnected ecosystem in which governance, learning processes, resources, and labour-market outcomes continuously influence one another. This study therefore adopts an ecosystem perspective to move beyond fragmented approaches that position vocational reform solely as a curriculum issue or a labour-market issue. Through a systematic synthesis of recent literature, the study seeks to provide a more integrated conceptual understanding of how governance, translational processes, resource configurations, and employability outcomes interact within SMK and TVET systems.

This study aims to develop a Vocational Education Ecosystem Framework (VEEF) through a Systematic Literature Review of industry partnership, curriculum alignment, educational financing, and employability in SMK and TVET. The study examines how industry partnerships shape governance and ecosystem coordination, how curriculum alignment translates labour-market demands into pedagogy and competencies, how educational financing supports implementation quality, innovation, and equity, and how the interaction among these dimensions influences employability and school-to-work transitions within vocational education systems.

METHOD

Research Design

This study applied a Systematic Literature Review (SLR) using a critical-interpretive synthesis approach to explore the interrelationships among industry partnership, curriculum alignment, educational financing, and employability within SMK and TVET systems. The SLR approach was chosen because it provides a structured and transparent procedure for identifying, evaluating, and synthesising relevant studies, while the interpretive orientation enables deeper conceptual integration beyond descriptive mapping of previous findings. To maintain methodological transparency, the review process followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework. The study concentrated on Scopus-indexed journal articles published between 2021 and 2026 to capture recent developments related to vocational education, labour-market transformation, digitalisation, and employability. Only peer-reviewed journal and review articles were included in the analysis, whereas conference papers, editorials, and non-peer-reviewed documents were excluded to ensure the credibility and consistency of the evidence base. The selection process consisted of identification, screening, eligibility assessment, and final inclusion stages. Figure 1 presents the PRISMA flow diagram used in this study.

Participants

Rather than involving human respondents, this study used scholarly publications as the primary source of data. The reviewed articles consisted of studies related to vocational education, SMK, TVET, employability, industry partnership, curriculum alignment, educational financing, and school-to-work transition. The articles were retrieved from the Scopus database through systematic search procedures using predefined inclusion and exclusion criteria. Studies were included if they: (1) focused on vocational education, TVET, SMK, vocational colleges, or comparable institutions; (2) addressed at least one of the key dimensions examined in this study, namely industry partnership, curriculum alignment, educational financing, or employability; (3) provided empirical, conceptual, or policy-related contributions; and (4) were published between 2021 and 2026. Meanwhile, studies were excluded if they were not directly related to vocational education contexts, lacked sufficient bibliographic information, or did not contribute meaningfully to the ecosystem analysis developed in this review. The final set of selected studies became the basis for thematic synthesis and conceptual interpretation.

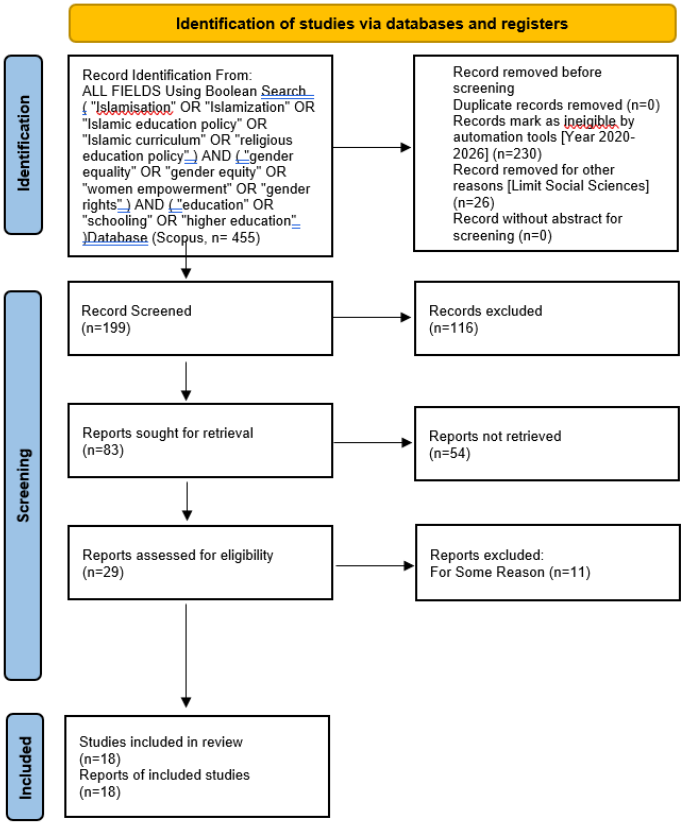

Figure 1. PRISMA flow diagram detailing the identification, screening, eligibility assessment, and final inclusion of literature in the systematic review.

Instrument

The main instrument used in this study was a systematic review protocol designed to guide the entire review process. The protocol covered database selection, keyword development, search strategies, inclusion and exclusion criteria, screening procedures, and thematic coding categories. The search process employed combinations of keywords and Boolean operators related to vocational education, TVET, SMK, industry partnership, curriculum alignment, educational financing, employability, work-based learning, and school-to-work transition. The search strings were refined iteratively to improve both relevance and comprehensiveness. In addition, thematic coding sheets were used to organise the selected studies according to context, conceptual orientation, methodological focus, and principal findings. This coding process supported the identification of recurring themes and relational patterns across the reviewed literature.

Data Analysis

The collected data were analysed through thematic synthesis combined with a critical-interpretive approach. In the initial stage, all selected studies were reviewed and coded based on their objectives, contexts, conceptual perspectives, and major findings. The coding results were then grouped into four central themes: industry partnership, curriculum alignment, educational financing, and employability. After the thematic categorisation stage, the analysis proceeded through axial synthesis to examine how these themes were interconnected within vocational education systems. Comparative reading was also conducted to identify convergences, differences, and recurring tensions across the literature, particularly regarding governance structures, curriculum translation, resource allocation, and labour-market outcomes. In the final stage, the analysis moved beyond descriptive synthesis toward conceptual integration. Through this interpretive process, the study developed the Vocational Education Ecosystem Framework (VEEF), which conceptualises vocational

education as an interconnected ecosystem consisting of Governance, Translational, Resource, and Outcome dimensions.

RESULTS AND DISCUSSION

RESULTS

Industry Partnership as Ecosystem Governance

The findings within this theme indicate that industry partnerships cannot be adequately understood as mere curriculum supplements, memoranda of understanding, or simple internship pathways. Based on eight articles in Table 1 published between 2021–2025 across seven contexts Malaysia (two studies), Kosovo, Indonesia, South Africa, China, Australia, and the BRICS countries, industry partnerships are more appropriately interpreted as ecosystem governance mechanisms linking schools or TVET institutions, firms, educators, regulators, and labour markets (Beka & Stublla, 2022; Billett & Le, 2024; Kaprawi, Rasi, Spöttl, Ismail, & Razzaly, 2021; Maltseva, Nikitin, Mehrotra, & Li, 2025; Mesuwini & Mokoena, 2023; Rohanai, Othman, Paimin, Ismail, & Razali, 2024; Sutiman, Sofyan, Arifin, Nurtanto, & Mutohhari, 2022; X. Wang, 2024).

Quantitatively, three dominant patterns emerge. First, apprenticeships or work-based learning appear in five out of eight studies (62.5%), specifically in Kaprawi et al. (2021), Sutiman et al. (2022), Mesuwini & Mokoena (2023), Rohanai et al. (2024), and X. Wang (2024). Second, public–private partnerships are identified in two studies (25%), namely Beka & Stublla (2022) and Maltseva et al. (2025). Third, local engagement partnerships are found in one study (12.5%), namely Billett & Le (2024). This pattern suggests that, in recent literature, industry partnerships most frequently manifest through direct workplace-based learning experiences.

However, the relationship between partnerships and vocational education outcomes is not automatic. Kaprawi et al. (2021) demonstrate that apprenticeships in Malaysia can support youth employment absorption, yet are constrained by weak instructor capacity, limited continuous professional development (CPD), and insufficiently robust collaboration. (Beka & Stublla, 2022) show that the sustainability of partnerships in Kosovo is strongly influenced by institutional governance structures. Sutiman et al. (2022) emphasise that industrial internships in Indonesia are only effective when orientation, planning, and instructional design are well developed. Mesuwini and Mokoena (2023) reveal that partnerships are also essential for upgrading teacher capacity through exposure to current industrial practices. Rohanai et al. (2024) further highlight that workplace experience becomes valuable only when translated into active pedagogical strategies. Wang et al. (2024) indicate that industry–academia collaboration strengthens technical, communication, teamwork, adaptability, and digital skills, although challenges remain regarding standards and placement quality. Billett and Le (2024) demonstrate the social legitimising function of partnerships in enhancing the attractiveness of vocational pathways, while Maltseva et al. (2025) show the role of public–private partnerships in modernising TVET systems across BRICS countries.

Overall, industry partnerships operate through four ecosystem functions: coordination, curriculum translation, capacity building, and social legitimacy. Nevertheless, nearly all studies report similar constraints, including weak supervision, uneven placement quality, inconsistent industry participation, and fragile coordination mechanisms. Therefore, the value of partnerships lies not in symbolic collaboration, but in their capacity to structure relationships, align expectations, deepen learning experiences, and facilitate school-to-work transitions. Within the Vocational Education Ecosystem Framework, industry partnerships should be positioned as a governance node that connects resources, curriculum, actors, and outcomes.

Table 1. Industry Partnership as Ecosystem Governance in SMK/TVET

No.	Verified Article (Authors, Year, Title)	Country / Context	Partnership Model	Main Actors	Governance Function in the Ecosystem	Reported Benefits	Reported Constraints
1	Kaprawi, N.; Rasi, R.Z.; Spöttl, G.; Ismail, A.; Razzaly, W. (2021) **Malaysian Apprenticeship Implementation: Issues and Challenges Towards Effective Employers Engagement**	Malaysia; manufacturing-sector apprenticeship/TVET	Employer-engaged apprenticeship	TVET providers, employers, instructors/coaches, policymakers	Coordinates employer participation and school-to-work transition pathways	Supports youth employment, local workforce supply, and regional development	Weak instructor/coach capacity, limited CPD, weak bridging programmes, limited provider–industry collaboration
2	Beka, A.; Stublla, P. (2022) **Comparing Public-Private Partnership of Vocational Education and Training Schools and Centres of Competence in Kosovo**	Kosovo; VET schools and centres of competence	Public–private partnership for internships and labour-market linkage	Schools, centres of competence, private firms, career-centre coordinators, teachers	Compares how institution types organise business collaboration and internship access	Improves cooperation with labour market and can expand graduate employment opportunities	Partnership sustainability varies by institutional governance structure
3	Sutiman, S.; Sofyan, H.; Arifin, Z.; Nurtanto, M.; Mutohhari, F. (2022) **Industry and Education Practitioners' Perceptions Regarding the Implementation of Work-Based Learning through Industrial Internship (WBL-II)**	Indonesia; vocational diploma education and automotive internships	Industrial internship / WBL-II	Diploma providers, industry practitioners, supervisors, internship students	Aligns internship orientation, planning, and curriculum with industry needs	Clarifies industry expectations and strengthens curriculum-integrated work-based learning	Internships have not yet generated strong positive impact; gaps in orientation, planning, and case-based competence
4	Mesuwini, J.; Mokoena, S.P. (2023) **TVET Lecturer Work-Integrated Learning: Opportunities**	South Africa; TVET lecturer–industry placement in mechanical sector	Lecturer work-integrated learning with industry placement	TVET lecturers, industry personnel, colleges	Builds teacher industry currency and feeds workplace knowledge back into teaching	Lecturers gain exposure to new machinery, processes, practices, and	Weak supervision/support, limited hands-on access to expensive machinery, poor induction

	and Challenges					professional networks	
5	Rohanai, R.; Othman, H.; Paimin, A.N.; Ismail, A.; Razali, S.S. (2024) **Exploring Teaching Strategies for Work-based Learning in TVET Practices: A Qualitative Study**	Malaysia; TVET work-based learning pedagogy	Work-based learning with experiential teaching strategies	TVET institutions, instructors, industry settings, learners	Translates workplace exposure into structured pedagogical delivery	Promotes active learning, reflection, enquiry, project execution, and competency testing	Teaching delivery often fails to match industry expectations; strategy design remains underdeveloped
6	Wang, W.; Hussin, M.; Majid, M.Z.A. (2024) **Employment Skills in Tertiary Work-Based Learning: A Multiple-Stakeholder Investigation into China's "3 + 1" Programmes**	China; tertiary "3+1" work-based learning programmes	Industry–academia collaboration in 3+1 WBL model	Students, educators, employers, tertiary institutions	Coordinates curriculum relevance, work placements, educator development, and feedback loops	Strengthens technical, communication, teamwork, adaptability, digital, and proactive skills	No stakeholder consensus on target skills; uneven work-placement quality
7	Billett, S.; Le, A.H. (2024) **Engaging Young People in Occupations Served by Vocational Education: Case Study From Healthcare**	Australia (Queensland); healthcare occupations linked to VET	Local engagement partnership for vocational pathways	Industry representatives, teachers/practitioners, healthcare providers, students, parents, communities, government	Organises local engagement, advice, and opportunity structures for pathway participation	Improves occupational awareness, participation, preparation, and retention prospects	VET pathways suffer from low attractiveness and require locally coordinated engagement
8	Maltseva, V.; Nikitin, M.; Mehrotra, S.; Li, J. (2025) **Private-Public Partnership in TVET: An Overview of Current Practices in the BRICS Countries**	BRICS; comparative TVET systems in Russia, India, and China	Public–private partnership in TVET modernisation	State agencies, industries, TVET institutions, national initiatives	Uses PPPs to modernise TVET, address resource gaps, and align training with labour markets	Improves curriculum relevance, practical training opportunities, workforce readiness, and employability	Effectiveness depends on governance arrangements and country-specific institutional conditions

Curriculum Alignment as a Translational Mechanism

The findings within this theme indicate that curriculum alignment is not merely a matter of matching competencies with industry needs, but rather a translational mechanism that connects labour market signals, qualification standards, pedagogical demands, and employability orientation into teaching content, assessment, learning strategies, and institutional design. Based on seven

articles in Table 2 published between 2023–2025, it is evident that the core challenge in vocational education is not the absence of reform, but the failure to translate curriculum reform into learning practices, assessment, teacher capacity, and linkages with the world of work.

Quantitatively, three out of seven studies (42.9%) emphasise work-integrated curriculum alignment through the integration of workplace experience and industry needs into curriculum transformation, namely (Suputra, Basuki, Gunawan, & Baghiz Syafruddin, 2024)Suputra et al. (2024), (Jewpanya et al., 2023)Jewpanya et al. (2023), and (Moreno, Callueng, & Portez, 2025)Moreno et al. (2025). Meanwhile, two studies (28.6%) focus on assessment and pedagogical alignment, namely (Yusop, Rasul, & Yasin, 2024)Yusop et al. (2024) and (Rachmawati, Suharno, & Roemintoyo, 2023)Rachmawati et al. (2023), highlighting that curriculum only becomes meaningful when translated into appropriate assessment and learning activities. The remaining two studies (28.6%) highlight qualification or programme alignment, namely (Affandi, Harahap, & Nawawi, 2024)Affandi et al. (2024) and (Majid, Sharil, & Kamaruzaman, 2023)Majid et al. (2023), emphasising the relationship between curriculum, qualification standards, and professional readiness.

Affandi et al. (2024) demonstrate that alignment must integrate certification systems, industry participation, governance, and curriculum development in order to unify technical and non-technical skills, learning outcomes, work-based training, and lifelong learning. However, its effectiveness is constrained by weak coordination, limited resources, outdated facilities, and low public awareness. Suputra et al. (2024) show that work-based curriculum transformation has a positive effect on learning experience, student competencies, and learning interaction, but these outcomes depend on teaching strategies capable of translating the curriculum into active and relevant practice.

Moreno et al. (2025) emphasise the importance of alignment in vocational teacher education curricula through programme restructuring, the introduction of new courses, and the strengthening of quality assurance so that teachers are prepared to respond to industry needs, innovation, and sustainability. Yusop et al. (2024) show that classroom-based assessment must be aligned with vocational skills, Industry 4.0 generic skills, and career adaptability. However, teacher-related constraints, inconsistent implementation, administrative burdens, and limited resources often weaken the translation of curriculum into assessment. Jewpanya et al. (2023), through the CWILE model, demonstrate that integrating stakeholder needs, extending work-integrated learning (WIL), and systematically evaluating competencies can enhance core, functional, and professional competencies. Majid et al. (2023) highlight the importance of curriculum mapping to ensure that teacher education curricula genuinely align with teaching demands in TVET contexts. Rachmawati et al. (2023) complement these findings by showing that alignment between HOTS-based curriculum design and learning activities influences the quality of the learning process, although teachers still face limitations in practical implementation understanding.

Overall, the seven studies reveal four layers of translation: from industry needs and qualification standards to curriculum structure; from curriculum to pedagogy; from curriculum to assessment; and from curriculum to employability (Affandi et al., 2024; Suputra et al., 2024; Moreno et al., 2025; Yusop et al., 2024; Jewpanya et al., 2023; Majid et al., 2023; Rachmawati et al., 2023). Notably, five out of seven studies (71.4%) explicitly incorporate soft skills, generic skills, communication, teamwork, problem solving, creativity, and career adaptability as part of curriculum alignment. At the same time, nearly all studies also report implementation challenges, such as weak coordination, limited resources, and insufficient teacher preparedness. This confirms that curriculum alignment is not only about what to teach, but also how to translate it and under what institutional conditions the curriculum is implemented. Therefore, within the Vocational Education Ecosystem Framework, curriculum alignment should be positioned as a primary translational layer that connects governance and resources with relevant learning and stronger

Table 2. Curriculum Alignment as a Translational Mechanism in SMK/TVET

No.	Verified Article (Authors, Year, Title)	Curriculum Orientation	Alignment Mechanism	Competency Domain Targeted	Pedagogical / Assessment Implications	Institutional Challenges	Reported Outcome for Relevance / Quality
1	Affandi, H.M.; Sohimi, N.E.; Subri, U.S.; Lazaro, M.H.; Yunus, F.A.N.; Yunus, S.N.M. (2024)**Fostering a Synergistic Approach to Curriculum Development and TVET-Engineering Qualifications**	TVET-engineering curriculum and qualification alignment	Integration of certification system, industry participation, governance framework, and curriculum development	Technical and non-technical skills; qualification-linked learning outcomes	Curriculum should be aligned with certification criteria, industry expectations, on-the-job training, and lifelong learning pathways	Lack of coordination, scarce resources, outdated materials/facilities, low public awareness	Stronger alignment between qualifications, curriculum, and labour-market needs; improved predictive validity for curriculum development
2	Suputra, I.N.; Basuki, A.; Gunawan, A.; Baghiz Syafruddin, A. (2024)**Does work-integrated curriculum transformation affect learning experience, student competencies, and learning interactions? The role of teaching strategy moderation**	Work-integrated curriculum in vocational secondary education	Curriculum transformation linked to world-of-work demands and moderated by teaching strategy	Student competencies, learning experience, learning interaction, work-oriented skill formation	Teaching strategy strengthens curriculum effects; curriculum must be translated into active learning practice, not only content redesign	Need for institutional strategy to connect curriculum reform with classroom delivery and labour-market orientation	Positive and significant effects on learning experience, competencies, and interaction; shows curriculum alignment works best when supported by pedagogy
3	Moreno, N.I.; Callueng, R.Z.; Portez, A.P. (2025)**Exploring Technical Vocational Teacher Education: Inputs to Curriculum Model Development**	Bachelor of Technical-Vocational Teacher Education (BTVTEd) curriculum model	Mixed-method curriculum review using expert input, emerging courses, industry-demand adaptation, and quality assurance practices	Pedagogy, instructional design, sustainability, innovation, professional development, industry-responsive teacher preparation	Calls for curriculum restructuring, inclusion of new courses, and stronger quality-assurance-informed delivery	Program design gaps, adaptation to industry demand, and resource/facility issues	New curriculum model proposed to improve TVET quality and graduate employability
4	Yusop, S.R.M.; Rasul, M.S.; Yasin, R.M. (2024)**Challenges, strengths, and relevance of integrating classroom-based assessment in technical and vocational education training**	Assessment-aligned TVET curriculum in secondary schooling	Integration of classroom-based assessment with vocational skills, Industry 4.0 generic skills, and career adaptability skills	Technical skills, IR 4.0 generic skills, career adaptability, cognitive-psychomotor-interpersonal outcomes	Assessment should measure broader learning outcomes beyond exams and better reflect curriculum mastery and industry-facing competencies	Teacher knowledge gaps, inconsistent implementation, reporting burden, weak coordination, limited materials and time constraints	Broader assessment alignment can strengthen student mastery and workforce preparedness

5	Jewpanya, P.; Nuangpirom, P.; Pitjamit, S.; Jaichomphu, P.; Chaithanul, K.; Sriyab, S. (2023)**Transforming Industrial Engineering Education: Introducing the CWILE Model for Work-Integrated Learning in the Digital Age**	Work-integrated industrial engineering curriculum	CWILE model combining stakeholder needs analysis, extended WIL design, and competency evaluation before–during–after instruction	Core, functional, and professional competencies for Industry 4.0-ready graduates	Longer and better-structured WIL should be embedded into curriculum, with explicit competency tracking across phases	Short WIL duration in current programs; insufficient opportunities for industry readiness; weak alignment between conventional curriculum and contemporary industrial needs	Positive growth across competency dimensions and stronger readiness for digital-age industry
6	Majid, F.A.; Sharil, W.N.E.H.; Kamaruzaman, M.F. (2023)**TESL Graduates and TVET English Language Teaching Readiness: The Curriculum Perspectives**	Teacher-education curriculum for TVET-related English instruction	Comparison of TESL programme learning outcomes with Malaysian Quality Agency TVET teaching competency objectives and "smart and sharp skills"	Practical skills, communication, teamwork, problem solving, lifelong learning, professional readiness for TVET teaching	Curriculum mapping is needed so teacher education prepares graduates to deliver TVET-relevant competencies, not only general TESL outcomes	Potential misfit between TESL curriculum design and TVET teaching demands; limited explicit exposure to targeted industry-relevant skill formation	Shows the importance of curriculum mapping and readiness analysis for specialised TVET teacher preparation
7	Rachmawati, D.; Suharno, S.; Roemintoyo, R. (2023)**The Effects of Learning Design on Learning Activities Based on Higher Order Thinking Skills in Vocational High Schools**	HOTS-oriented vocational curriculum design	Alignment of lesson planning and learning implementation using Anderson & Krathwohl-based knowledge dimensions and 4C/HOTS elements	Critical thinking, creativity, collaboration, communication, metacognitive and procedural learning	Curriculum implementation quality depends on teacher planning knowledge and the translation of HOTS into classroom activities	Teachers' insufficient knowledge about HOTS-based learning design; weak planning-implementation linkage	Better learning-design alignment is associated with improved quality of vocational learning activities

Educational Financing as Enabling Infrastructure

The findings within this theme indicate that educational financing cannot be positioned merely as an administrative backdrop or a supplementary element to vocational reform. Based on seven articles in Table 3 published between 2021–2025, financing is more appropriately understood as an enabling infrastructure that determines whether industry partnerships, curriculum alignment, work-based learning, and transition support can operate at an adequate level of quality. While Chapter 1 emphasises that vocational education in many countries faces a paradox between policy expansion and weak employment outcomes, the literature in this theme reveals one of its core roots: reforms are often burdened with targets of relevance and employability, yet are not consistently supported by sufficiently robust, stable, and equitable resource configurations.

Quantitatively, two out of seven studies (28.6%) focus on systemic financing through public–private partnerships or co-investment schemes, namely Maltseva et al. (2025) and Voeller (2025). Another two studies (28.6%) highlight financial support for access and completion, particularly for WIL costs, scholarships, student services, and the quality of learning experience, as shown by Nogcantsi and Mbatha (2025) and Tadle et al. (2021). Meanwhile, the remaining three studies (42.9%) emphasise resource provisioning at workplace, programme, or institutional levels, including support for apprenticeships, learning environments, enterprise compensation, workshop facilities,

and innovation under funding constraints, as evidenced by Ullibarriarana-Garate et al. (2024), Power-Mason et al. (2025), and Guta (2025). This distribution suggests that financing in TVET literature concerns not only the size of budgets, but also who finances, what is financed, and how these allocations reshape institutional capacity to produce learning outcomes and employability.

Maltseva et al. (2025) demonstrate that public–private partnerships in BRICS countries are utilised to modernise TVET, address resource constraints, and enhance the labour-market relevance of training. In this study, financing functions as an instrument of system modernisation: it underpins curriculum renewal, the provision of practical infrastructure, and the strengthening of industry linkages. However, the effectiveness of this model depends on governance structures, institutional capacity, and varying national configurations. This finding reinforces the argument in Chapter 1 that skills ecosystems are inherently contextual and that financing is not a neutral variable, but part of institutional design shaping the trajectory of reform.

Voeller (2025) further develops this dimension through a study of enterprise-based training in the ICT sector in the Philippines. It shows that the expansion of company-based training is heavily influenced by incentive structures, cost-sharing arrangements, tax benefits, and wage frameworks. In other words, education–industry partnerships will not develop optimally if participation costs for firms are too high or if incentive schemes are ineffective. This finding is critical as it highlights that financing is not only about public expenditure, but also about how systems design incentives to encourage industry actors to act as co-producers of skills.

The equity dimension is particularly pronounced in the study by Nogcantsi and Mbatha (2025). They demonstrate that student financial support, including funding for work-integrated learning, transport, accommodation, and placement-related costs, significantly influences the completion of technical diploma programmes in TVET. When funding covers only theoretical learning but excludes WIL requirements, disadvantaged students become the most vulnerable to delayed graduation and constrained school-to-work transitions. This aligns with the discussion in Chapter 1, which calls for viewing TVET not only from a productivity perspective but also through the lenses of capability and equity.

Tadle et al. (2021) report a similar pattern in the context of private HEI-TVET in the Philippines. They show that service quality, training facilities, student support, and scholarship availability are closely linked to students' learning experiences. Here, financing clearly shapes the quality of the learning environment. When service support and facilities are inadequate, the perceived quality of training declines. This implies that even when TVET programmes are available, outcomes remain uneven if financial support and institutional services are insufficient.

At the level of workplace experience, Ullibarriarana-Garate et al. (2024) demonstrate that the quality of apprenticeships in higher education is determined not only by the availability of placements but also by the quality of workplace resources, including supportive environments, access to meaningful learning experiences, and the availability of job resources. This study indicates that financing and resource provision at the workplace level influence not only learning processes but also career satisfaction and long-term orientation.

Power-Mason et al. (2025) examine the English context, where higher education apprenticeships are under financial and regulatory pressure. Interestingly, the study finds that funding constraints can stimulate innovation, collaboration, and more adaptive forms of student support. However, such innovation occurs within a fragile context, as limited resources threaten programme sustainability and scalability. This adds an important nuance: financing is not only about adequacy, but also about system resilience in the face of crisis and regulatory change.

Guta (2025) provides strong evidence from Ethiopia that enterprise participation in cooperative training is influenced by compensation, protection against training-related risks, the availability of workshops and equipment, and capacity-building support for mentors and instructors.

When compensation is minimal and firms bear high risks without protection, industry participation tends to weaken. This reinforces the argument from Section 3.1 that the quality of industry partnerships is strongly shaped by how costs and benefits are distributed within the ecosystem.

Overall, the seven studies reveal three primary functions of financing within the vocational education ecosystem. First, financing acts as a system capacity enabler, particularly for curriculum modernisation, infrastructure development, and industry linkages (Maltseva et al., 2025; Voeller, 2025). Second, it serves as a guarantor of access and equity, especially when supporting completion, WIL participation, student services, and the quality of learning experiences (Nogcantsi & Mbatha, 2025; Tadle et al., 2021). Third, it functions as a driver of implementation quality, through workplace resources, apprenticeship support, enterprise compensation, and institutional innovation under constraints (Ullibarriarana-Garate et al., 2024; Power-Mason et al., 2025; Guta, 2025).

Notably, all seven studies (100%) explicitly link financing or resources to implementation quality, innovation, access, or employability. This indicates that financing is not a peripheral factor, but a central node determining whether vocational reforms can be realised in practice. At the same time, nearly all studies highlight sustainability challenges, including weak governance, inefficient incentives, inadequate WIL funding, uneven facility quality, regulatory pressures, and cost burdens on enterprises (Maltseva et al., 2025; Voeller, 2025; Nogcantsi & Mbatha, 2025; Tadle et al., 2021; Ullibarriarana-Garate et al., 2024; Power-Mason et al., 2025; Guta, 2025). Therefore, financing must be understood not only in budgetary terms, but as part of governance and strategic prioritisation.

In conclusion, these findings support the central argument of the article that educational financing should be positioned as a core ecosystem variable in SMK and TVET. Without adequate, targeted, and equitable financing, industry partnerships remain fragile, curricula are difficult to translate into high-quality practice, and employability remains a normative goal without sufficient material foundation. Within the Vocational Education Ecosystem Framework, financing serves as the enabling infrastructure that connects governance, curriculum alignment, and school-to-work transitions in a more sustainable manner.

Table 3. Educational Financing as Enabling Infrastructure in SMK/TVET

No.	Verified Article (Authors, Year, Title)	Financing Source / Model	Spending Focus / Resource Logic	Level of Analysis	Equity or Access Dimension	Observed Effect on Quality / Innovation	Constraints or Sustainability Issues
1	Maltseva, V.; Nikitin, M.; Mehrotra, S.; Li, J. (2025)**Private-Public Partnership in TVET: An Overview of Current Practices in the BRICS Countries**	Public-private partnership (PPP) and co-investment arrangements in TVET modernization	Financing curriculum modernization, practical training infrastructure, and industry-linked delivery capacity	National / comparative (Russia, India, China within BRICS)	Addresses system-level capacity gaps in emerging economies and seeks broader labour-market alignment	PPPs help address resource limitations, strengthen curriculum relevance, and expand practical training opportunities; they also improve employability orientation	Effectiveness depends on governance structure, industrial participation, and country-specific institutional capacity; sustainability varies across national contexts
2	Voeller, J. (2025)**Challenges and Strategies for Expanding Enterprise-Based Training to Develop**	Enterprise-based training framed as both a private and public good; incentives,	Financing wage schedules, longer training duration, employer participation incentives, and sector-based EBT expansion	National / sectoral (Philippines, ICT industry)	Expanding affordable employer participation can widen high-quality skill formation opportunities	Better financing and incentive design can make EBT more viable for firms and	Wage requirements, inefficient tax benefits, weak social-partner involvement, and lengthy standards

	Skills for the ICT Industry in the Philippines	tax benefits, and cost-sharing logic are central			in a growing sector	strengthen skills pipelines for technology-oriented employment	processes restrict scalability
3	Nogcantsi, B.; Mbatha, L.L. (2025)**Whispers of potential: Barriers to qualification completion of National Accredited Technical Education Diploma programmes in a selected TVET College**	Student financial support model (NSFAS) plus proposed integration with SETA and WIL-related support	Funding for Work-Integrated Learning (WIL), transport, accommodation, placement-related costs, and completion support	Institutional / college level (South African TVET)	Strong equity dimension because underfunded students are most exposed to delayed completion and blocked transitions to work	Adequate financial support is linked to stronger qualification completion and better employability prospects	Existing support covers theoretical study more than mandatory WIL; weak placement funding and administrative hurdles undermine completion
4	Ullibarriarana-Garate, A.; Agirre-Aramburu, I.; Mesonero-De Miguel, M.; Sánchez-Urien, N. (2024)**Higher education apprenticeship. Analyzing the impact and essential conditions of workplace resources on apprentices' career satisfaction**	Workplace resource provisioning within apprenticeship systems	Job resources, supportive workplace environment, access to meaningful learning experiences, and resource-backed apprenticeship quality	Program / institutional level (Spanish dual apprenticeship degree)	Highlights how uneven workplace resources shape learner experience and developmental return from apprenticeship participation	Resource-rich apprenticeships improve learning opportunities and apprentices' career satisfaction	Sustainability depends on consistent workplace support and equitable access to quality learning resources across placements
5	Tadle, R.L.; Valdez, L.P.; Fernandez, R.; Uy, C.; de Castro, B. (2021)**Students' Experience of Service Quality of Technical Vocational Education and Training (TVET) Programs in Philiphines's Private Higher Educational Institutions (HEIs)**	Private HEI-TVET resourcing model, including scholarship-linked access and student-support provisioning	Training quality, student support services, training facilities, and institutional service delivery	Institutional level (private HEI-TVET, Philippines)	Scholarship availability and support-service adequacy are tied to students' access and quality of learning experience	Better support services and facilities are associated with stronger perceived training quality and more supportive learning conditions	Uneven service quality and facility adequacy can weaken the developmental value of TVET participation, especially in private provision contexts
6	Power-Mason, P.; Charlton, H.; Walker-Martin, F.; Bloomfield, S. (2025)**A Sector**	Funding-constrained apprenticeship delivery within	Personalized support, progress monitoring, collaborative provision, and	Sector / institutional level (England, higher	Reveals how funding pressure can affect continuity and	Resource pressure has driven innovation, collaboration	Rising regulatory pressure, financial constraints, and resource

	in Crisis? Insights from how English Higher Education Apprenticeships are Weathering the Storm	higher education; innovation under financial pressure	adaptive institutional practices under resource constraint	education apprenticeships)	quality of apprenticeship provision and, by extension, access to high-support learning pathways	, and adaptive student-support practices among apprenticeship providers	limitations threaten long-term sustainability and scalability
7	Guta, K.S. (2025)**Perceptions of TVET instructors on the involvement of enterprises in cooperative training**	Cooperative-training support model involving compensation for enterprise participation and protection against training-related damages	Enterprise compensation, workshop/equipment provision, instructor and mentor capacity-building, and monitoring support	Regional / institutional level (Oromia, Ethiopia)	Resource constraints disproportionately affect peripheral TVET colleges with weaker workshop capacity and fewer enterprise options	Better compensation and resource support can improve enterprise willingness, practical training capacity, and cooperative-training quality	Minimal compensation, no warranty for damages, enterprise capacity limits, and weak planning/assessment involvement undermine implementation

Employability as a Systemic Outcome

The findings within this theme indicate that employability cannot be understood merely as an individual attribute of graduates, but rather as a systemic outcome emerging from the interaction between curriculum, learning experiences, industry exposure, digital capacity, and institutional support. Based on seven articles in Table 4 published between 2022–2025, the literature shows that work readiness, job readiness, and graduate employability are not simply the result of individual student effort, but reflect how effectively the vocational education ecosystem connects learning, work experience, future competencies, and labour-market demands. This argument is consistent with Chapter 1, which positions employability as a relational outcome, and Chapter 2, which emphasises the importance of interpreting outcomes through cross-study synthesis rather than single indicators.

Quantitatively, two out of seven studies (28.6%) emphasise soft skills and communication/collaboration as key determinants of employability, namely Hidayatulloh and Ashoumi (2022) and, partially, Kamaruzaman et al. (2025). Another two studies (28.6%) highlight digital, generic, and future-oriented skills, namely Wong and Abdullah (2025) and Kholifah et al. (2025). Meanwhile, two further studies (28.6%) identify industry-linked learning structures as critical factors, namely Ichwanto and Ansyorie (2023) and Alam and Sharmin (2023). The remaining one study (14.3%) emphasises psychomotor ability as the primary basis of work readiness, namely Mulyono et al. (2025). This distribution indicates that employability in contemporary TVET literature is shaped by at least four clusters of determinants: soft skills, digital and generic skills, industry-based learning experiences, and technical/psychomotor competencies.

Hidayatulloh and Ashoumi (2022) demonstrate that communication and collaboration are positively associated with vocational students' work readiness. This finding is important as it confirms that employability is shaped not only by technical competence, but also by the quality of social interaction and the ability to work collaboratively. In the context of Chapter 1, this supports the argument that human capital theory alone is insufficient to explain labour-market outcomes, as graduate quality is also influenced by relational capacities developed within learning environments.

Ichwanto and Ansyorie (2023) reinforce this systemic perspective through their study on the teaching factory model. They show that industry collaboration significantly influences production-

based learning models and that learning outcomes are closely linked to work preparedness. This suggests that employability emerges not only from classroom instruction, but from the integration of school management, facilities, industry collaboration, and production-based learning experiences. These findings align with Sections 3.1 and 3.2, which highlight that governance and curriculum alignment become meaningful only when translated into authentic learning experiences.

Alam and Sharmin (2023) offer a distinct perspective through their study on Japanese language skill development within TVET programmes in Bangladesh. They demonstrate that the combination of language skills, vocational skills, and labour-market orientation can strengthen sustainable employability, including opportunities for both domestic and international employment. This finding highlights that employability is not only about matching skills with local industry needs, but also about enabling vocational education systems to access broader labour markets.

Kamaruzaman et al. (2025) show that TVET employability is shaped by clusters of generic skills, including teamwork, communication, creativity, problem-solving, adaptability, digital literacy, technical skills, career adaptability, and lifelong learning. As a systematic review, this study is important because it consolidates evidence that employability is not a single construct, but a layered set of interconnected capabilities. This finding also reinforces the discussion in Chapter 1 regarding the shift from purely technical skills to more complex future-oriented competencies.

At a more specific level, Wong and Abdullah (2025) find that the job readiness of TVET students in the Electrical and Electronics field remains at an "approaching readiness" level, with variation across institutions. The study emphasises the importance of technical knowledge, reasoning, problem-solving, technological literacy, big data, AI, communication, leadership, and lifelong learning. This finding is significant because it shows that even though Industry 4.0 demands are well defined, institutions are not always able to translate them consistently into student capabilities. Thus, employability also serves as an indicator of institutional capacity to respond to technological transformation.

Kholifah et al. (2025) provide strong large-scale evidence, based on 2,587 vocational high school graduates in Yogyakarta, that digital employability skills significantly influence workforce readiness. The study demonstrates that digital communication and collaboration act as the strongest mediating mechanisms in shaping work readiness. Among all articles in the table, this is the only study with a large sample size, thereby adding significant weight to the argument that employability increasingly depends on graduates' ability to work, communicate, and adapt within digital environments.

Mulyono et al. (2025) complement this perspective by emphasising the role of psychomotor abilities among vocational students in the Building Information Modeling and Design field. They show that psychomotor skills aligned with industry tasks significantly influence work readiness. This finding is important as it reminds us that, despite the growing emphasis on soft and digital skills, employability in vocational education still depends on the quality of technical competence manifested in actual work performance.

Taken together, the seven studies indicate that employability operates through at least four systemic pathways. First, the relational capacity pathway, including communication, collaboration, teamwork, and other generic skills that strengthen work readiness (Hidayatulloh & Ashoumi, 2022; Kamaruzaman et al., 2025). Second, the industry-based learning pathway, which connects teaching factory models, occupational language, and labour-market contexts to graduate preparedness (Ichwanto & Ansyorie, 2023; Alam & Sharmin, 2023). Third, the digital and future skills pathway, which is increasingly central in the Industry 4.0 era (Wong & Abdullah, 2025; Kholifah et al., 2025). Fourth, the technical–psychomotor pathway, which remains foundational for work readiness in specific sectors (Mulyono et al., 2025).

Notably, all seven studies (100%) in Table 4 explicitly link employability to more than one determinant. None of the articles conceptualises employability as the result of a single skill alone. This indicates that contemporary TVET literature increasingly views employability as a multidimensional construct. At the same time, the diversity of indicators, ranging from work readiness, job readiness, graduate employability, and career sustainability to employment preparation, shows that labour-market outcomes in vocational education are still conceptualised through varied terminologies. However, this diversity strengthens the conclusion that employability represents the convergence point of multiple systemic processes, rather than a standalone end result.

In conclusion, the findings in this theme support the central argument of the article that employability is the outcome through which the effectiveness of the vocational education ecosystem becomes visible. While Section 3.1 identifies industry partnerships as a governance node, Section 3.2 positions curriculum alignment as a translational layer, and Section 3.3 establishes financing as an enabling infrastructure, this theme shows that employability emerges as the final manifestation of how these three elements interact. When communication, industry experience, future skills, and technical competence are developed in an integrated manner, employability improves. Conversely, when one ecosystem node is weak, work readiness becomes fragile. Therefore, within the Vocational Education Ecosystem Framework, employability should be understood not merely as a personal attribute, but as the most tangible indicator of the quality of systemic coordination in vocational education.

Table 4. Employability as a Systemic Outcome in SMK/TVET

No.	Verified Article (Authors, Year, Title)	Employability Definition / Indicator	Population / Institutional Context	Main Determinants Identified	Measurement Approach	Key Findings	Ecosystem Implication
1	Hidayatulloh, M.K.Y.; Ashoumi, H. (2022)**The Perspective of Work Readiness in Vocational School Students with 21st Century Communication and Collaboration Skills**	Work readiness of vocational students, linked to communication and collaboration skills	Vocational school students; Indonesia	Communication competence and collaboration/teamwork as key soft-skill drivers of readiness	Quantitative survey using work-readiness scale, communication instrument, and teamwork scale	Communication and collaboration skills are positively associated with vocational students' work readiness	Employability is shaped not only by technical preparation, but by soft-skill ecosystems embedded in school learning and interaction
2	Ichwanto, M.A.; Ansyorie, M.M.A. (2023)**Sister-cousin TF Model Based on the Influence of Work Preparedness and Learning Outcome**	Work preparedness / employment preparation of vocational students	Eight public and private vocational schools in six cities, East Java, Indonesia	Teaching factory quality, industry collaboration, infrastructure, management, soft skills, and learning outcomes	Mixed-method design with observations, questionnaires, interviews, and SEM-PLS	Industry collaboration significantly affects the teaching factory model, and learning outcomes are strongly linked to work preparedness	Employability emerges from an integrated school–industry production-learning system, not from classroom training alone
3	Alam, M.J.; Sharmin, D. (2023)**Skills Development for Graduate**	Sustainable graduate employability linked to skill	TVET-related skills development in Bangladesh, with Japanese-	Combination of language skills, vocational skills, and labour-market relevance for	Empirical study examining the impact of Japanese	Skills-development programs tied to specific	Employability is improved when vocational

	Employability in Bangladesh: Japanese Language in TVET Program	development and labour-market value	language program orientation	domestic and overseas employment	language program on skills development and employability	labour-market demand can strengthen sustainable employability	training is connected to market-facing skill niches and opportunity structures
4	Kamaruzaman, F.M.; Othman, N.N.J.N.; Omar, M.; Zaid, M.F.A.M. (2025)**Future Generic Skills for Technical Vocational Education Graduates**	Employability and job readiness framed through future generic skills for TVET graduates	TVET graduates; systematic review context	Teamwork, communication, creativity, problem-solving, adaptability, digital literacy, technical skills, career adaptability, and lifelong learning	Systematic literature review synthesizing 11 relevant studies	Three major clusters emerge: generic skills and employability, digital and technical competencies, and integration of transversal competences	Employability is a layered outcome produced by curricular, pedagogical, and cross-sector alignment around future-oriented competencies
5	Wong, G.S.; Abdullah, N.S. (2025)**Job Readiness Level to Address 4.0 Skills: An Empirical Study on TVET Students in Electrical and Electronics Field**	Job readiness of final-year TVET students in relation to Industry 4.0 skills	Final-year TVET undergraduate students in the Electrical and Electronics field across the Malaysia Technical University Network (MTUN)	Technical knowledge, reasoning/problem solving, analytical thinking, technological literacy, big data, communication, AI, leadership, lifelong learning, quality control, critical thinking	Quantitative descriptive survey using Industry 4.0 skills checklist and job-readiness questionnaire; comparative analysis across institutions	Students are only at an "approaching readiness" level, and readiness differs significantly across institutions	Employability depends on how far TVET institutions can convert industry 4.0 demands into actual student capability and institutional consistency
6	Kholifah, N.; Nurtanto, M.; Sutrisno, V.L.P.; Majid, N.W.A.; Subakti, H.; Daryono, R.W.; Achmadi, A. (2025)**Unlocking Workforce Readiness through Digital Employability Skills in Vocational Education Graduates: A PLS-SEM Analysis Based on Human Capital Theory**	Workforce readiness / graduate employability in the digital labour market	2,587 vocational high school graduates in Yogyakarta, Indonesia	Digital communication and collaboration, digital creativity and production, ICT resource integration, technology adaptation, problem-solving, and specific software skills	Large-scale survey with 37 indicators analyzed using PLS-SEM	Digital communication and collaboration acts as the strongest mediating mechanism in shaping digital employability and readiness	Employability is not only a function of technical skills, but of digitally networked capacities that connect learning, collaboration, and productivity
7	Mulyono, W.D.; Suparji, S.; Wardhono, A.; Adistana, G.A.Y.P.;	Work readiness of vocational high school students in	Final-year vocational students in Building Information	Psychomotor skills aligned with industrial tasks and technical drawing competence	Quantitative ex post facto study using questionnaires,	Psychomotor ability significantly supports work	Employability depends on the quality of embodied

	Suryaman, H.; Artaningtyas, D.R. (2025)**Analysis of Psychomotor Abilities and Their Influence on The Work Readiness of Vocational Students**	relation to psychomotor ability	Modeling and Design programs across the Gerbangkertosusila region, East Java, Indonesia	observation sheets, descriptive analysis, and path analysis	readiness and should be strengthened through instruction aligned to industry demands	technical competence, not only on cognitive or attitudinal preparation

Synthesized Model

The conceptual synthesis of Sections 3.1–3.4 indicates that vocational education does not operate in a linear manner, but rather through interconnected relationships among governance, curriculum translation, resources, and outcomes. Based on consistent patterns identified in the literature, this article proposes the Vocational Education Ecosystem Framework (VEEF) to explain that the success of SMK and TVET is determined by the quality of interconnections among components, rather than by any single factor. Within this framework, industry partnerships function as system drivers, curriculum as a translation mechanism, financing as a capacity enabler, and employability as a reflection of ecosystem performance.

The Governance Node comprises industry partnerships, the role of the state, and intermediary actors. Evidence from Table 1 shows that strong partnerships can connect schools with labour market needs and strengthen coordination across actors (Kaprawi et al., 2021; Wang et al., 2024; Maltseva et al., 2025). This node determines the direction and quality of interactions within the vocational system.

The Translational Node includes curriculum, pedagogy, certification, and teacher capability. Table 2 highlights that curriculum is only effective when it is genuinely translated into learning practices and assessment (Affandi et al., 2024; Suputra et al., 2024; Yusop et al., 2024). Teachers play a central role in this process, as they bridge curriculum design and authentic learning experiences.

The Resource Node encompasses financing, infrastructure, student support, and innovation capacity. Table 3 demonstrates that without adequate resource support, partnerships and curricula cannot be implemented effectively (Nogcantsi & Mbatha, 2025; Guta, 2025; Power-Mason et al., 2025). Conversely, strong financing enhances implementation quality and system sustainability.

The Outcome Node includes employability, school-to-work transition, adaptability, and equity of opportunity. Table 4 shows that these outcomes result from the interaction of various factors, such as industry experience, soft skills, and digital competencies (Ichwanto & Ansyorie, 2023; Kholifah et al., 2025; Mulyono et al., 2025). Thus, employability is not merely an individual outcome, but an indicator of overall system quality.

The relationships among nodes are reciprocal. Industry partnerships influence curriculum design and work-based learning. Financing strengthens translational capacity and implementation quality. Together, the three primary nodes shape outcomes. At the same time, outcomes feed back into the system strong outcomes enhance legitimacy and trust, while weak outcomes drive ecosystem redesign.

Visually, VEEF is best represented as a circular or layered model, emphasising reciprocal rather than linear relationships. In this model, governance provides direction, translation converts direction into practice, resources sustain implementation, and outcomes serve both as indicators and as mechanisms for system learning. Therefore, the most appropriate position for the attached diagram is immediately after this explanatory paragraph, because the preceding text has already introduced the four nodes and the reciprocal logic of the framework. Placing the figure here enables readers to

move directly from conceptual explanation to visual synthesis, before the section closes with the broader theoretical implication of VEEF.

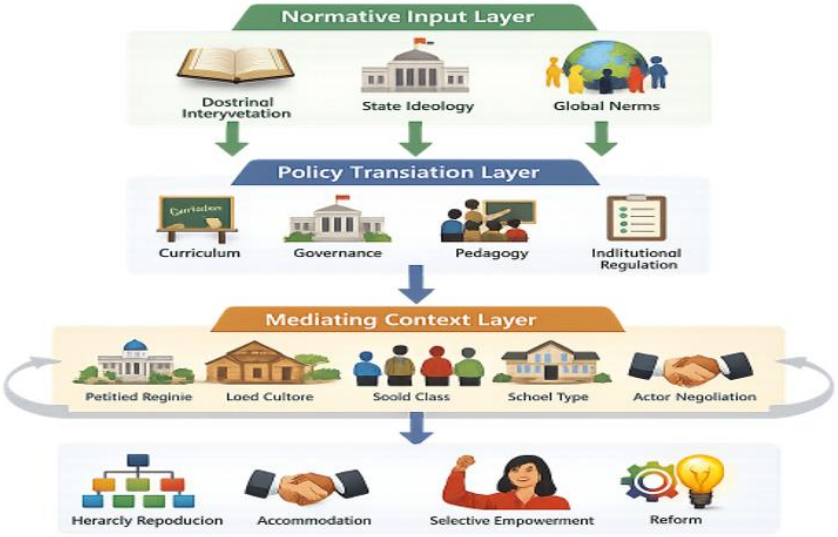

Figure 2. Vocational Education Ecosystem Framework (VEEF): a reciprocal systems model linking governance, curriculum translation, resourcing, and employability outcomes in SMK and TVET.

Figure 2 visualises the central conceptual synthesis of this section by showing that vocational education systems operate through reciprocal rather than linear relationships. The four main nodes Governance, Translational, Resource, and Outcome represent the interconnected architecture of VEEF. The Governance Node shapes how partnerships, state coordination, and intermediary actors guide curriculum and work-based learning. The Translational Node converts labour-market needs into pedagogy, assessment, certification, and teacher capability. The Resource Node strengthens implementation through financing, infrastructure, student support, and innovation capacity. The Outcome Node represents employability, school-to-work transition, adaptability, and equity of opportunity. The feedback arrow from the Outcome Node is especially important because it shows that outcomes are not the endpoint of the system; they return to influence legitimacy, adaptation, and redesign. Thus, Figure 2 directly supports the argument that the effectiveness of SMK and TVET depends on the quality of dynamic connections among ecosystem components.

In conclusion, VEEF asserts that effective vocational education can only be achieved through strong integration among governance, curriculum, resources, and outcomes. This model offers a more realistic framework for understanding how vocational systems operate, while also providing a foundation for more systemic policy development and future research.

Discussion

The findings of this review indicate that employability within SMK and TVET cannot be interpreted as the product of a single educational intervention or isolated reform agenda. Rather, employability emerges from the interaction among industry partnership, curriculum alignment, educational financing, and institutional coordination operating within a broader vocational education ecosystem (Vlachopoulos & Pachni Tsitiridou, 2026; Zhou & Deng, 2025). Across the reviewed studies, these dimensions repeatedly influence one another in shaping learning quality, workplace exposure, resource availability, and school-to-work transitions (Choudhry & Pastore, 2023). This suggests that the effectiveness of vocational education depends not only on the competencies possessed by graduates, but also on how educational institutions, industries, labour markets, and policy environments are connected within the system.

Within this ecosystem, industry partnership appears to function as an important governance mechanism rather than merely a supplementary form of collaboration. Apprenticeships, work-based learning, teaching factories, and public–private partnerships provide pathways through which vocational institutions can strengthen curriculum relevance and expose students to authentic workplace environments (Johnson, 2024). Nevertheless, the literature also shows that partnerships do not automatically produce positive outcomes. Their effectiveness depends largely on coordination quality, institutional commitment, continuity of collaboration, and the capacity of stakeholders to maintain reciprocal relationships over time (Liu, 2021). In this context, industry engagement becomes meaningful when it contributes to long-term ecosystem coordination instead of symbolic cooperation alone.

The findings further demonstrate that curriculum alignment serves as the translational layer connecting labour-market expectations with pedagogy, assessment, certification, and competency development. Several studies suggest that curriculum reform often fails to generate substantial impact when it remains limited to formal redesign without effective implementation in teaching and workplace learning practices (Ghanbaripour et al., 2024; Zolak Poljašević et al., 2025). This condition highlights the central role of teachers, pedagogical strategies, and institutional readiness in translating curriculum objectives into meaningful learning experiences. At the same time, the increasing emphasis on digital literacy, adaptability, problem-solving ability, and transversal competencies reflects broader labour-market changes associated with technological transformation and Industry 4.0.

Another important pattern emerging from the review concerns the role of educational financing. The findings indicate that financing should not be viewed simply as administrative support, but as enabling infrastructure that shapes implementation quality, innovation capacity, access, and institutional sustainability ("POLICY AND INSTITUTIONAL INNOVATION FOR SUSTAINABILITY," 2025). Adequate financial support influences infrastructure development, teacher capacity building, student services, workplace learning opportunities, and industry collaboration. Conversely, weak or uneven financing often limits the sustainability of partnerships, reduces the quality of work-based learning, and constrains curriculum implementation (Bilderback, 2025). These patterns reinforce the argument that financing is not a peripheral issue within vocational education reform, but a central ecosystem variable affecting how institutional strategies operate in practice.

The review also reveals that employability is increasingly understood as a multidimensional outcome rather than merely a measure of technical competence. Across the reviewed studies, employability is associated with communication skills, teamwork, adaptability, digital capability, workplace experience, and problem-solving ability alongside occupational expertise (Mahajan et al., 2022). Such findings indicate that work readiness develops through the interaction between curriculum, institutional support, workplace exposure, and learning environments rather than through technical training alone. From this perspective, employability reflects the overall quality of coordination within the vocational education ecosystem.

Taken together, these findings support the development of the Vocational Education Ecosystem Framework (VEEF), which conceptualises vocational education as a reciprocal system consisting of Governance, Translational, Resource, and Outcome dimensions. Within this framework, industry partnership functions as the governance node coordinating institutional and labour-market relationships; curriculum alignment operates as the translational node connecting industry demands with pedagogy and competency formation; educational financing acts as the resource node supporting implementation capacity and sustainability; while employability represents the outcome node reflecting ecosystem performance. Importantly, the relationships among these dimensions are reciprocal rather than linear (Howard et al., 2022; Ojeda et al., 2022). Weaknesses in one dimension

may reduce the effectiveness of the others, whereas stronger coordination among governance, curriculum, financing, and employability contributes to more sustainable school-to-work transitions and stronger vocational education outcomes.

From a broader perspective, the findings imply that vocational education policy should move beyond fragmented reforms that focus only on curriculum redesign or labour-market alignment. More integrated strategies are required to strengthen governance quality, financing systems, institutional collaboration, teacher capacity, and workplace learning structures simultaneously (Hidayat, 2024; Sarker, 2021). This issue is particularly relevant in developing-country contexts, where institutional inequality, limited resources, and uneven industry participation continue to influence vocational education performance (Hidayat, 2024). Therefore, improving employability within SMK and TVET requires not only competency-oriented reform, but also stronger ecosystem coordination capable of connecting governance, learning processes, resources, and labour-market demands in a coherent and sustainable manner.

Implications

This study provides important implications for vocational education policy and practice by demonstrating that employability within SMK and TVET is shaped through the interaction among industry partnership, curriculum alignment, educational financing, and institutional coordination rather than through isolated reforms alone. The proposed Vocational Education Ecosystem Framework (VEEF) offers a more integrated perspective for understanding how governance, learning processes, resource allocation, and labour-market outcomes are interconnected within vocational education systems. The findings also suggest that policymakers and vocational institutions need to strengthen long-term industry collaboration, adaptive curriculum implementation, equitable financing mechanisms, teacher capacity, and workplace learning opportunities simultaneously in order to support more sustainable school-to-work transitions and improve employability outcomes.

Limitations

This study has several limitations that should be considered when interpreting the findings. The review focused only on Scopus-indexed journal articles published between 2021 and 2026, which means that relevant studies from other databases, earlier publications, or non-English sources may not have been included. In addition, because the study relied on previously published literature, the synthesis was influenced by the methodological approaches, conceptual orientations, and contextual differences of the reviewed studies (Barry et al., 2022). Therefore, the Vocational Education Ecosystem Framework (VEEF) developed in this study should be understood as a conceptual synthesis intended to provide theoretical integration rather than a universally fixed model applicable to all vocational education contexts.

Suggestions

Future research is recommended to examine the Vocational Education Ecosystem Framework (VEEF) empirically across different SMK and TVET contexts using quantitative, qualitative, or mixed-method approaches. Further studies may also explore additional ecosystem dimensions such as technological infrastructure, digital transformation, policy decentralisation, social inequality, and community participation in order to enrich understanding of vocational education systems (Das, 2024). From a practical perspective, policymakers and vocational institutions are encouraged to design more integrated vocational education strategies that simultaneously strengthen governance coordination, curriculum responsiveness, financing sustainability, and employability development to support more adaptive and resilient school-to-work transition systems.

CONCLUSION

This study highlights that the success of SMK and TVET is closely connected to how vocational education systems integrate industry partnership, curriculum alignment, educational financing, and employability within a broader institutional ecosystem. The review shows that employability is not produced solely through curriculum reform or technical training, but develops through continuous interaction among governance structures, learning processes, workplace experiences, and resource support. Industry partnership contributes to ecosystem coordination and labour-market relevance, curriculum alignment translates industrial needs into competencies and pedagogy, while financing provides the capacity required for sustainable implementation and equitable access. These interconnected findings form the basis of the Vocational Education Ecosystem Framework (VEEF), which conceptualises vocational education through Governance, Translational, Resource, and Outcome dimensions operating reciprocally rather than linearly. Overall, the study suggests that improving school-to-work transitions and vocational education outcomes requires more integrated and sustainable ecosystem-based strategies capable of connecting institutional collaboration, curriculum responsiveness, financing capacity, and labour-market demands within SMK and TVET systems.

AUTHOR CONTRIBUTIONS STATEMENT

Sungkem Tri Wahyuni contributed to the conceptualization of the study, literature review process, data analysis, framework development, and manuscript writing. Nurul Astuti Yensy contributed to research design, methodological validation, data interpretation, and critical revision of the manuscript. Sudarwan Danim contributed to theoretical refinement, supervision, academic review, and final approval of the manuscript. All authors read and approved the final version of the article.

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