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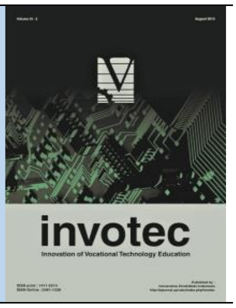

IMPLEMENTATION STRATEGIES FOR INDUSTRY INTEGRATION MODELS IN VOCATIONAL EDUCATION LEARNING

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A B S T R A C T

The gap between what vocational graduates can do and what employers in the labor market actually require has become a central concern for vocational education in the digital era, and industry integration is widely treated as the means by which that gap may be narrowed. This study set out to examine how industry integration models are put into practice within vocational education learning. A systematic literature review was conducted, and 53 articles published in international journals between 2021 and 2025 were analyzed. Ten implementation strategies were identified and were grouped into four orientations that are curriculum based, pedagogical, structural, and technological: industry-based curriculum development, industry-based project learning, strategic industry-institution partnerships, the use of digital technology and industry simulation, structured apprenticeship programs, dual system learning models, the strengthening of educators' capacity through industry experience, industry standard-based certification systems, block systems in vocational learning, and work station-based rotation learning. When examined together, the strategies were found to reinforce one another, and several factors were seen to shape whether implementation succeeds. A framework is therefore proposed to guide institutions and policymakers in designing integrated approaches suited to their circumstances. The novelty lies not in any single strategy but in how the strategies are synthesized and interpreted.

1. Introduction

Few parts of the education system are tied as directly to the world of work as vocational education, whose purpose is the preparation of skilled workers who are able to meet the needs of industry. In recent years that purpose has been made more demanding. The working world has been reshaped by Industry 4.0 and by digital transformation, and as a result new competencies are required and learning approaches that can be adapted more readily than the conventional ones are now called for (Demir & Erişen, 2021; Hernandez-de-Menendez et al., 2021). When the skills held by graduates and the expectations held by employers are not aligned, a gap is created, and this skills gap is now regarded as a global problem for which innovative and collaborative solutions are being sought (Healy et al., 2022).

That industry integration models can be effective, by this point has been well established in the vocational education literature. Something else, however, has been missing. Earlier reviews have tended to examine individual strategies or single national cases (Alharahsheh et al., 2021), and no comprehensive framework has yet been offered through which the implementation strategies behind these models can be identified, classified, and interpreted based on evidence assembled from across countries. Because syntheses of that kind remain scarce, institutions are frequently left to select and adapt strategies for their own settings with little to draw upon, and the choice is made more difficult than it should be. It is this absence that the present review was designed to address.

2. Method

A systematic literature review (SLR) was adopted so that the implementation strategies associated with industry integration models in vocational education learning could be identified and analyzed. The design was chosen deliberately. Where the aim is for a scattered body of recent work to be drawn together, for the practices that recur across it to be brought out, and for the places in which knowledge remains thin to be made visible, an SLR is better suited to the task than a narrative review would be.

2.1 Process and Methodological Framework

The review was organized around the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework, and four stages were followed. The research questions were formulated first; the literature was then searched; the retrieved studies were selected and evaluated; and the findings were finally analyzed and synthesized. A single question guided the whole process. What strategies are used to implement the industry integration model in vocational education learning according to the most recent research (2021 to 2025), how are those strategies related to and reinforced by one another, and how might they be applied, once appropriate adaptation has been made, to the contexts of Indonesia and Southeast Asia?

2.2 Search Strategy

Five international databases were searched. These were Scopus, Web of Science, ERIC, ProQuest, and the Directory of Open Access Journals (DOAJ), and each was selected for its relevance to vocational education and for its coverage of international journals. The search terms were combined in various ways and included "vocational education," "TVET," "industry integration," "industry partnership," "work-based learning," "implementation strategy," "industry-education collaboration," and "industry-based learning."

2.3 Inclusion, Exclusion, and Eligibility Criteria

Six conditions had to be met before a study could be included. It had to be a research article that appeared in a reputable international journal; it had to be open access; it had to have been published between 2021 and 2025; it had to be written in English; it had to deal specifically with implementation strategies for industry integration models in vocational education, and the mechanisms, processes, or approaches involved had to be described rather than merely alluded to; and it had to appear in one of the indexed databases that are listed in Table 1.

The initial search returned 247 articles. After 43 duplicates had been removed and the inclusion criteria had been applied at the level of titles and abstracts, 128 records were retained for full-text review. The studies that were set aside at this point were excluded chiefly because their primary focus lay somewhere other than implementation strategies (37 articles), because they were unrelated to vocational education (28 articles), or because they had not been peer reviewed (10 articles). The set was then narrowed further through full-text reading and quality appraisal, and 53 articles were ultimately judged to satisfy every criterion and were carried into the final review (Figure 1). Of the studies that were dropped at this later stage, most were excluded because implementation strategies had been described only thinly (41 articles), because the methodology was weak (23 articles), or because the argument rested on conceptual claims for which no empirical support was provided (11 articles).

Quality was appraised with the Mixed Methods Appraisal Tool (MMAT). Five dimensions were attended to in particular: how clearly the research questions had been stated, how appropriate the data collection methods were, how sound the analysis was, the degree to which context had been taken into account, and the reflexivity that was shown by the researchers. Each study was rated against these dimensions, and any article that scored below 60% was excluded. The studies that were retained therefore met at least a moderate standard of methodological quality.

Table 1. Inclusion and Exclusion Criteria

No	Inclusion Criteria	Exclusion Criteria
1	Peer-reviewed articles from international journals or conference proceedings	Non-peer-reviewed articles (magazine articles, newspapers)
2	Publications in English	Publications in languages other than English
3	Implementation Strategies For Industry Integration Models In Vocational Education Learning	Articles only discussing Industry Integration Models In Vocational Education Learning
4	Articles with accessible full text	Duplicate publications or identical articles
5	Scopus, Web of Science, ERIC, ProQuest, and Directory of Open Access Journals (DOAJ)	Articles without substantial implementation strategies discussion
6	Articles published January, 2021 to March, 2025	Grey literature (technical reports, working papers)

2.4 Data Extraction and Analysis

Data were drawn from each study with a structured extraction form that had been built in Microsoft Excel. Nine fields were recorded. These were the bibliographic details, the research objectives, the context and geographical setting, the methodology, the types of implementation strategy, the mechanisms and processes through which those strategies were enacted, the factors by which they were supported or hindered, the results and impacts that were reported, and, finally, the implications and recommendations that were offered.

A three-stage thematic procedure was followed in the analysis. Open coding was carried out first, and the substantive fields of the extraction form were read line by line so that the key concepts could be captured; 86 initial codes were generated in this way. These codes were then drawn together through axial coding into 24 sub-categories; the sub-categories being formed as the relationships among the codes were traced. Selective coding was applied last, and the material was consolidated and refined into the 10 main implementation strategies that are reported here. Coding was judged to have reached saturation once further reading of the corpus produced no new codes. The whole process was managed in NVivo 14, by which the tracking of emerging themes and the visualization of the connections among strategies were made easier. So that the reliability of the interpretation could be protected and individual bias limited, the material was coded independently by more than one researcher, and the points on which they disagreed were reconciled through discussion until agreement was reached.

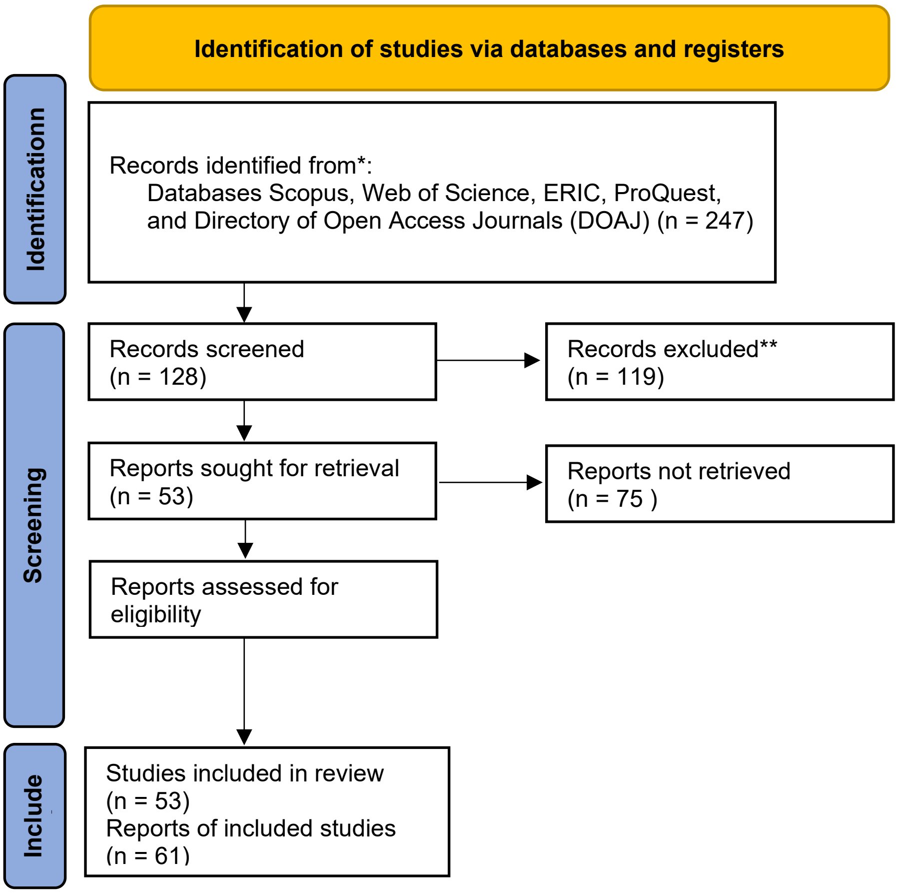

Figure 1. PRISMA Flowchart: Article Selection Process

3. Results and Discussion

3.1 Strategies in implementing industry integration models in vocational education learning

From the systematic analysis of the 53 selected articles, ten principal strategies for implementing industry integration models in vocational education learning were identified. These were sorted, according to their dominant orientation, into four groups that are curriculum based, pedagogical, structural, and technological, as is set out in Table 2. In Figure 2 all ten are placed side by side, and the level of industry involvement that each one calls for is compared against the complexity of putting it into practice.

Table 2: Classification of Implementation Strategies for Industry Integration Models

Orientation	Implementation Strategy	Level of Industry Involvement	Implementation Complexity	Key Prerequisites
Curriculum-based	Industry-Based Curriculum Development	High	Medium	Formal collaboration mechanisms, institutional willingness for curriculum change
	Development of Industry Standard-Based Certification Systems	High	High	Structured industry standards, regulatory support

Orientation	Implementation Strategy	Level of Industry Involvement	Implementation Complexity	Key Prerequisites
Pedagogical	Implementation of Industry-Based Project Learning	Medium-High	Medium	Mentor capacity, collaborative evaluation mechanisms
	Implementation of Block Systems in Vocational Learning	Medium	Medium-High	Academic calendar flexibility, coordination with industry
	Development of Work Station-Based Rotation Learning Systems	High	High	Access to various industry departments, structured assessment processes
Structural	Development of Strategic Industry-Institution Partnerships	High	Medium-High	Leadership support, vision alignment, resource sustainability
	Development of Structured Apprenticeship Programs	High	High	Trained mentors, comprehensive assessment system, supportive regulatory framework
	Implementation of Dual System Learning Models	High	High	Distribution of learning responsibilities, coordination mechanisms
	Strengthening Vocational Educators' Capacity Through Industry Experience	Medium	Medium	Professional development programs, flexibility in educator assignments
Technological	Utilization of Digital Technology and Industry Simulation	Low-Medium	Medium	Technological infrastructure, digital competence of educators

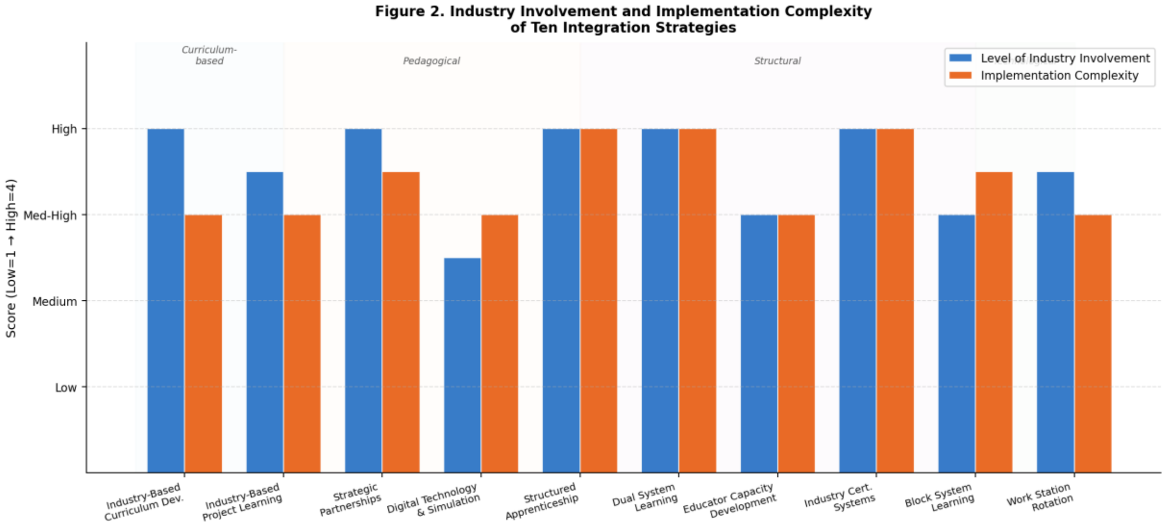

Figure 2. Industry Involvement and Implementation Complexity of Ten Integration Strategies

3.1.1 Industry-Based Curriculum Development

Among the curriculum-based strategies, industry-based curriculum development may be regarded as the most foundational, since through it the perspective of industry is carried directly into what is taught. Three features tend to be associated with it: an orientation toward competencies, a capacity for adaptation as technologies change, and a deliberate alignment with the needs of the labor market (Chinedu et al., 2021; Berner et al., 2023). Whether it can be implemented well, however, is governed by several conditions.

The first condition is that industry participation be genuine. Where at least 30% of a curriculum committee is made up of practitioners, the learning materials that are produced have been found to be markedly more relevant than those drawn up from academic input alone (Pham et al., 2023; Khurshid & Khan, 2021). A co-creation model of this kind allows authentic industry requirements to be reconciled with academic standards; for it to work, however, the effectiveness of that involvement must be tracked against clear success metrics and not simply assumed (Thomas et al., 2021; Liu et al., 2022).

3.1.2 Implementation of Industry-Based Project Learning

Industry-based project learning is a pedagogical strategy of a somewhat different character, since through it authentic industry cases and projects are folded into the learning process itself. Projects that arise from real industry needs are taken on by students, and as the work proceeds they are guided by educators and industry mentors together (Ramírez-Montoya et al., 2021).

When the strategy is implemented well, the work is moved through four phases. Suitable industry projects are identified and selected first; planning and preparation are then carried out in full; implementation is monitored as it proceeds; and the outcomes are evaluated and disseminated at the end (Schmidt et al., 2022). Whether the effort succeeds is determined largely by the choice of project. Its complexity must be matched to what students are able to handle, its relevance to the learning objectives must be clear, and demonstrable value must be held for the industry partner.

Evidence from Germany suggests that the gains from this approach are not confined to technical ability, and that transversal skills such as problem-solving, teamwork, and professional communication are strengthened alongside it (Putra et al., 2022; Kobayashi et al., 2022; Babu et al., 2022). The longitudinal picture is a striking one. Graduates who had undertaken at least three industry projects during their training were found to be 47% more work-ready than peers whose education had been conventional throughout (Gessler & Siemer, 2023).

A technological dimension is present in all of this as well. When current industry technologies are built into the projects, the knowledge that students acquire is made both more relevant and more readily applicable, and the practical bearing of theoretical concepts tends to be grasped more deeply by those who work on technology-intensive projects than it otherwise would be (Yılmaz & Kaygin, 2021).

3.1.3 Development of Strategic Industry-Institution Partnerships

Sustainable integration rests, in the end, on the partnerships that an institution is able to build with industry. Such partnerships take various forms, and they range from loose, ad-hoc cooperation at one extreme to durable institutional collaboration at the other (Chen et al., 2022; Cedefop, 2022; Feng et al., 2023; Nordlund & Bonfanti, 2022). How effective any of them proves to be is dependent on a small number of factors.

A shared vision is the first of these. The goals of the institution and those of the industry partner must be brought into alignment in a way by which the interests and priorities of each side are respected (Lee et al., 2022; Peterson et al., 2022). It is also helpful for these objectives to be set down formally, in a memorandum of understanding or an operational agreement, since something firm is given by such documents on which both program development and later performance evaluation can rest.

Governance is of no less importance. Partnerships are sustained more easily where joint steering committees, implementation teams, and regular channels of communication have been established, and effectiveness is improved further where a governance matrix is used so that the roles, responsibilities, and contributions expected of each party across the various areas of cooperation can be spelled out (Davids et al., 2023; Ono et al., 2022).

Transparent communication, clearly defined roles, support from leadership, and a mutual recognition of what is contributed by each side are named repeatedly among the conditions for success (Duran & Martinez, 2022; Olsen et al., 2021). The experience of Singapore's polytechnics is instructive in this regard. It is shown by that experience how much can be achieved when industry relationships are built and managed systematically, and the obstacles that tend to recur are also identified: differences of organizational culture, limited resources, and expectations about outcomes that are not always shared by the two sides (Goh et al., 2021; Qin et al., 2022).

3.1.4 Utilization of Digital Technology and Industry Simulation

Room has been opened by digital transformation for industry experience to be brought into vocational learning by other means, that is, through simulation, through virtual and augmented reality, and through digital learning environments more broadly. Where direct access to industry is limited, the gap is bridged in part by these technologies, and skills are allowed to be developed in settings that are at once safe and controlled (Suharno et al., 2023; Silva Santos & Guimarães, 2021; Dobricki et al., 2021; Kopp et al., 2023).

A work environment can be reproduced convincingly enough by virtual reality (VR) and augmented reality (AR) for the benefits to be measured. In manufacturing-related vocational training, VR-based instruction has been associated with knowledge retention that is 32% higher and practice errors that are 28% fewer than under conventional methods (Jensen et al., 2021; Fu et al., 2022; Thees et al., 2022). Their value is greatest, unsurprisingly, where the learning context carries real risk or where the equipment that would otherwise be required is prohibitively expensive.

3.1.5 Development of Structured Apprenticeship Programs

Of all the forms that industry integration takes, the structured apprenticeship is the most intensive, since learners are placed directly in the workplace for extended periods. How effective such a program will be is determined by a number of elements, among them the quality of the mentoring provided (Wong et al., 2022; Park et al., 2021; Rodriguez et al., 2022; Rupietta et al., 2021).

3.1.6 Implementation of Dual System Learning Models

In the dual system, institutional study and structured workplace learning are run in parallel rather than in sequence, and several components are called for if the arrangement is to work (Gessler & Siemer, 2023; Härtel et al., 2021).

The structure depends, above all, on a clear division of responsibility between school and firm. This is usually set out in a responsibility matrix by which each competency is assigned to one party or the other. Theoretical foundations are made the province of the institution and practical application that of the industry partner, so that little ambiguity remains about who is accountable for what (Gessler & Siemer, 2023).

3.1.7 Strengthening Vocational Educators' Capacity Through Industry Experience

Much of whether these models work in practice is decided by the educators themselves, and in particular by how current their own industry experience is. Teachers who have recently spent time in industry are better placed to connect theory with practice and to design learning experiences by which the requirements of the workplace are genuinely reflected (Wahba et al., 2022; Sandoval et al., 2023; Smith et al., 2021).

Professional development of this industry-based kind is delivered in a variety of ways: through teacher attachment schemes and industry sabbaticals, through collaborative projects, and through instructor-in-residence arrangements by which practitioners from industry are brought in to teach part-time within the institution (Hassan et al., 2021; Nore & Lahn, 2021; Zhou et al., 2022).

3.1.8 Development of Industry Standard-Based Certification Systems

Weight is lent to the competencies that a graduate claims to hold by certification that is built on industry standards, and those competencies are thereby made both more recognizable and more credible to employers. Where such certification is woven into a program, more than one credential is held by students on leaving, and their employability is improved accordingly (Zhang & Cheng, 2022).

For this to be put in place, the curriculum must first be mapped against the certification standards, so that any gaps between what is taught and what certification demands can be located and then deliberately closed (Zhang & Cheng, 2022; Nguyen et al., 2022). Access is of importance too. Where assessment and certification centers are hosted by institutions themselves, certification is obtained far more often, and acquisition rates that are some 68% higher have been reported at institutions with such facilities than at those without them (Martinez et al., 2023).

Micro-credentials and digital badges, by which specific competencies are acknowledged one at a time, fit the wider international move toward more granular forms of recognition, and through them a portfolio of industry-recognized skills can be assembled by students over time (Ismail et al., 2024).

3.1.9 Implementation of Block Systems in Vocational Learning

Rather than several subjects being spread across a term at once, as is done under the traditional timetable, learning is concentrated under block systems on one subject or competency at a time in intensive stretches. For industry integration, a number of advantages are carried by this way of organizing study (Mohr et al., 2023).

Several models exist. Under block-release arrangements, a concentrated period of perhaps three to six weeks is spent by students in industry before they return to the institution, by which industrial processes can be followed in depth and the fragmentation of learning is reduced (Mohr et al., 2023). Competency-block approaches instead organize study around clusters of related competencies, by which the material is given greater coherence and comprehensive mastery is made easier to reach than under separate-subject schemes (Nakayama et al., 2022). Integrated project blocks go further still, since intensive periods are devoted to comprehensive projects that are staffed by cross-disciplinary teaching teams and industry mentors, so that students' capacity to bring several competencies to bear on a single complex problem may be developed (Zhang et al., 2024).

Comparative work from Japan lends support to the approach. At institutions by which block systems had been adopted, on-time completion rates that were 24% higher and successful workplace transitions that were 31% higher were recorded than at those keeping to traditional schedules. The gains, it should be said, were not obtained without cost: scheduling flexibility, close coordination with industry, and careful pedagogical planning were all required if they were to be realized (Nakayama et al., 2022).

3.1.10 Development of Workstation-Based Rotation Learning Systems

Learning is organized by workstation rotation as a sequence. A series of stations, each of which stands for a different industrial process or department, is moved through by students, and in this way they are exposed to the breadth of an industry's operations (Vargas et al., 2022).

Here too several models are in use. Under industry-simulated rotation, stations that reproduce real industrial settings are built by the institution, so that structured learning can take place in controlled conditions under close pedagogical supervision (Lin & Park, 2023). Under industry-based rotation, students are instead moved through actual departments within partner firms on a planned schedule, by which a first-hand sense of how functions depend on one another, and of the industry as a system, is given to them (Vargas et al., 2022). Hybrid models combine the two, since campus simulation is paired with time in real industrial environments so that the control and safety of the former may be kept while the authenticity of the latter is gained (Lin & Park, 2023).

Rounded competencies are built effectively by systems of this kind. End-to-end workflows come to be understood by students, and industrial operations come to be viewed as a whole rather than in parts. Graduates who have been through such systems also meet assignments that cut across departments with greater readiness later on (Vargas et al., 2022; Lin & Park, 2023).

How well it works depends on the design. The rotation must be planned with care, the station experiences must be lined up with the formal curriculum, and moments of reflection must be provided so that students can knit together what was learned at one station with what was learned at the next (Vargas et al., 2022). It is suggested by research from China, in addition, that rotation need not stand alone, and that it can be combined with project-based learning and structured apprenticeships so that a fuller learning experience may be built (Wang et al., 2021).

Table 3. Cross-Strategy Synergy Matrix

Strategy	S1 Curric.	S2 Cert.	S3 Project	S4 Block	S5 Rotation	S6 Partner	S7 Apprent.	S8 Dual	S9 Educator	S10 Digital
S1 Curric.	-	M	H	M	M	H	M	M	M	M
S2 Cert.	M	-	M	L	L	M	H	M	L	M
S3 Project	H	M	-	H	M	H	H	H	H	H
S4 Block	M	L	H	-	H	M	M	H	M	M
S5 Rotation	M	L	M	H	-	M	H	M	M	H
S6 Partner	H	M	H	M	M	-	H	H	H	M
S7 Apprent.	M	H	H	M	H	H	-	H	M	M
S8 Dual	M	M	H	H	M	H	H	-	M	H
S9 Educator	M	L	H	M	M	H	M	M	-	H
S10 Digital	M	M	H	M	H	M	M	H	H	-

Note: H = High Synergy; M = Moderate Synergy; L = Low Synergy; — = Not Applicable.

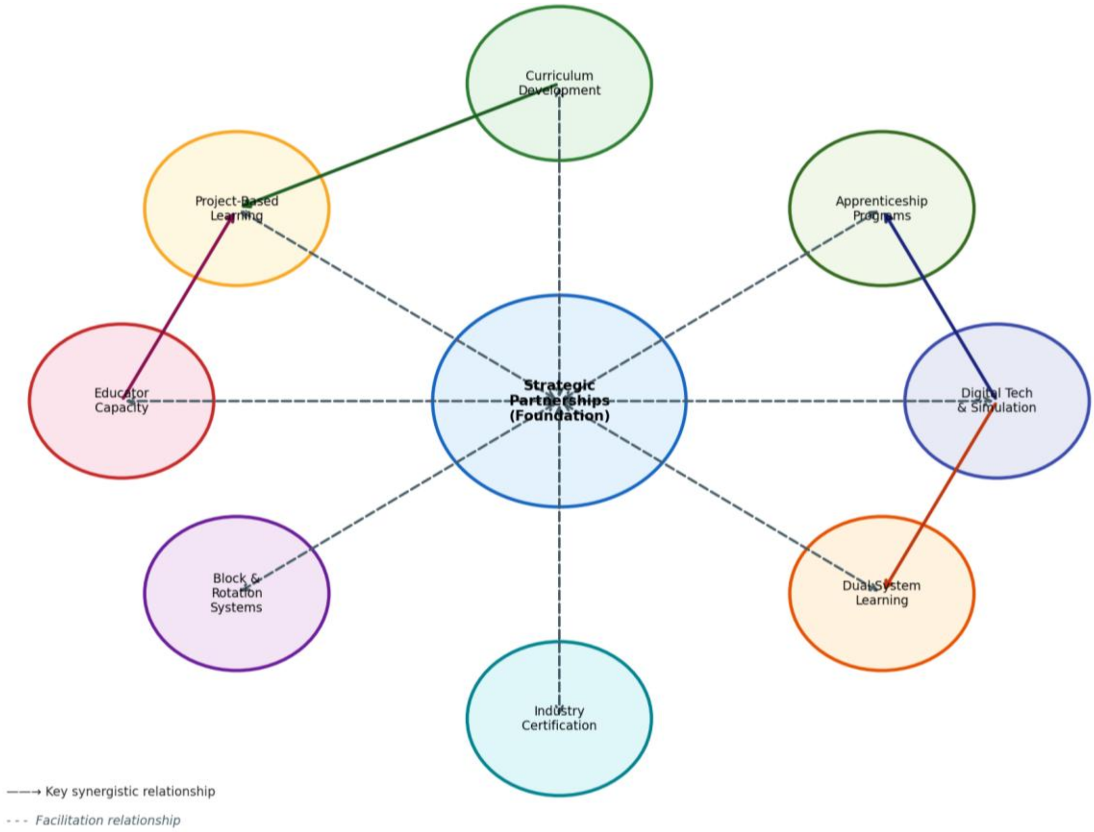

Figure 3. Inter-Strategy Synergy Framework: Strategic Partnerships as the Central Hub

3.2 Cross-Strategy Synthesis and Inter-Relationship Analysis

When they are looked at as a set rather than one by one, the ten strategies are found to be bound together by relationships of mutual reinforcement, and these relationships are worth the attention of any institution by which their adoption is being planned. A distinction can be drawn, in this light, between strategies of high impact, among which strategic partnerships, structured apprenticeship, and project-based learning are prominent, and supporting strategies such as certification, block systems, and rotation, by which the high-impact strategies are enabled and extended. The degree to which each pair of strategies reinforces the other is summarized in the cross-strategy synergy matrix of Table 3, while in Figure 4 the same relationships are rendered as a framework in which strategic partnerships are placed at the center and the rest are facilitated from there.

These patterns are not merely descriptive, and they may be read through several established theoretical lenses. The emphasis on competencies and on employability is consistent with Human Capital Theory, by which education is treated as an investment in productive capacity. The interdependence among institutions, industry, and government that runs through the partnership and certification strategies reflects the Triple Helix Model, while the importance attached to the wider system of relationships, regulation, and incentives is captured by Skills Ecosystem Theory. The strategies in which learning is situated in real or simulated workplaces, among them apprenticeship, dual systems, and rotation, are most readily understood through Work-Integrated Learning Theory, and the movement of students and knowledge across the boundary between school and firm, together with the brokering role played by educators with industry experience, is illuminated by Boundary Crossing Theory. Interpreted in this way, the ten strategies cease to be a catalogue and become an integrated account of how the worlds of education and work are brought together.

Curriculum and pedagogy are integrated in the first synergy. Industry-based curriculum (3.1) and project-based learning (3.2) are reinforced by one another with particular force. The conceptual groundwork is laid by the first, since industry input is built into what is taught, and the means by which that groundwork is put authentically into practice are supplied by the second. Where both are adopted together, substantial improvement in graduate workplace readiness and in the relevance of the program to industry has been observed (Pham et al., 2023; Schmidt et al., 2022).

Physical learning is enhanced by technology in the second. Digital technology and simulation (3.4) act as an enabler both for workstation rotation (3.10) and for structured apprenticeship (3.5). Students are allowed by simulation to prepare virtually before they are placed in physical settings, by which the time spent in real workplaces is made more productive and, at the same time, the problem of limited access to industry facilities is eased. That problem is felt most acutely where resources are scarce (Suharno et al., 2023; Lin & Park, 2023).

Educator capacity is treated, in the third, as the foundation. Strengthening educator capacity (3.7) is less a strategy that stands alongside the others than a precondition for most of them. Teachers by whom recent industry experience is carried act as the bridge between theoretical concepts and practical application, and where they are present the quality of project-based learning and the effectiveness of apprenticeship programs are both raised appreciably (Wahba et al., 2022; Camacho & Legare, 2021).

Partnership is taken, in the fourth, as the infrastructure. Strategic partnerships (3.3) supply, in the end, the institutional framework on which everything else is built. From a robust partnership the platform is created out of which collaborative curriculum work, apprenticeship placements, educator development, and the other forms of integration can all proceed (Chen et al., 2022; Abdullah et al., 2022).

Cutting across the individual strategies, four factors were found by the analysis to bear on whether implementation succeeds, whichever strategy happens to be in play.

1. The first is policy and regulatory frameworks. Where the policy environment is supportive, the rest is made easier: curricula can be kept flexible, qualification standards can be aligned, apprenticeship arrangements can be established, and resources can be allocated where they are needed (Zhao & Chen, 2021; Zhang & Cheng, 2022; Fernandez & Garcia-Martinez, 2021).
2. The second is multi-stakeholder coordination. Because so many parties are involved, among them institutions, industry partners, and regulatory bodies, the quality of the coordination among them is often what decides whether a given strategy is implemented successfully (Duran & Martinez, 2022; Abdullah et al., 2022).
3. It should be acknowledged that the strategies are not equally transferable, and that the conditions under which they succeed differ from one setting to another. In developed systems, where industry partners are well resourced and regulation is mature, capital-

intensive strategies such as dual systems and structured apprenticeship tend to be sustained with relative ease. In developing systems, by contrast, where small and medium enterprises predominate and mentor capacity is limited, the same strategies are harder to sustain, and the lower-cost, modular strategies are often the more realistic point of entry. Trade-offs are therefore unavoidable. The authenticity that is gained from placement in real workplaces is purchased at the cost of control and scalability, whereas the safety and reach that are offered by simulation are purchased at the cost of some authenticity. Which balance is appropriate is determined less by the merits of a strategy in the abstract than by the resources, the regulatory support, and the industrial structure of the context in which it is to be applied.

Table 4. Contextual Adaptation Framework for Indonesian TVET Implementation

Strategy	Priority	Adaptation for Indonesian TVET	Key Stakeholders
Industry-Based Curriculum Development	High	Involve corporate and industrial sector in curriculum committees ≥30%; Align with Indonesian National Work Competency Standards; Integrate local industry characteristics	National Professional Certification Agency, Ministry of Education, Indonesian Chamber of Commerce and Industry, Indonesian Employers Association
Strategic Partnerships	High	Develop Small-Medium Enterprise (SME)-specific models; utilize Committee for Inter-Parliamentary Cooperation; create cluster-based industry-school networks	Regional Government, Professional Certification Coordinating Board, SME Associations
Digital Technology & Simulation	High	Prioritize for remote/rural areas; leverage Southeast Asian Ministers of Education Organization (SEAMEO) digital programs; align with Making Indonesia 4.0	SEAMEO, Agency for the Assessment and Application of Technology, Industry 4.0 Tech Providers
Educator Capacity Development	High	Expand teaching factory instructor industry attachment; integrate into Teacher Professional Education Programs	Teacher Training Institution, National Professional Certification Agency, Industry
Industry Certification Systems	Medium	Integrate National Professional Certification Agency certification; establish Competency Test Center at vocational schools; leverage micro-credentials	National Professional Certification Agency, Professional Certification Body
Block System Learning	Medium	Adapt to Workplace-Based Training structures; design 4-8 week intensive industry blocks coordinated with school calendar	Ministry of Education, Corporate and Industrial Sector Partners
Work Station Rotation	Medium	Implement within teaching factory environments; partner with local manufacturers for rotation in SME clusters	Teaching Factory Operators, Local Industry Clusters
Structured Apprenticeship	Medium	Align with Workplace-Based Traininand magang programs; establish mentor quality frameworks; scale through BLUD	National Professional Certification Agency, Provincial Education Offices, Industry
Dual System Learning	Low-Medium	Pilot in provinces with strong industry bases (Banten, West Java, East Java); develop from Vocational High School-Corporate and Industrial Sectorframeworks	Ministry of Education, Provincial Governments
Industry-Based Project Learning	High	Integrate within teaching factory project systems; connect to local government development projects	Teaching Factory Coordinators, Local Government, Industry

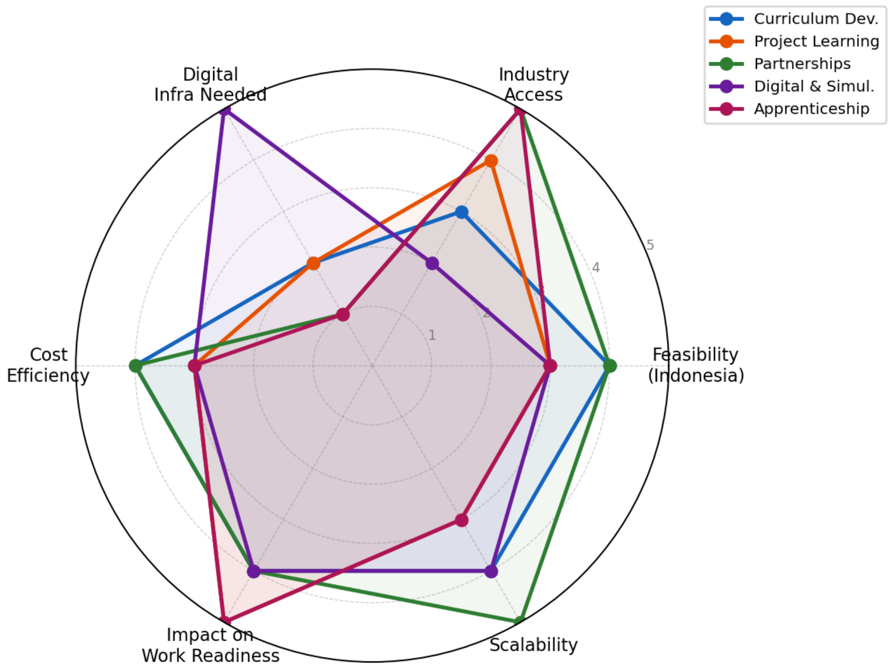

Figure 4. Contextual Suitability Radar Chart for Key Strategies in Indonesian TVET Context

3.3 Contextual Application for Indonesia and Southeast Asia

For these strategies to be carried over to Indonesia, and to comparable settings elsewhere in Southeast Asia, attention must be paid to what makes the region distinctive. Indonesia is geographically dispersed, its industrial base is uneven, and the gap in development between one region and another is wide; for all these reasons, implementation cannot simply be transplanted but must instead be adapted. A prioritized adaptation framework for the Indonesian TVET context is laid out in Table 4, and in Figure 3 the contextual suitability of the leading strategies is assessed by means of a radar chart, on which each strategy is rated from low to high against dimensions such as industry access, feasibility, scalability, cost efficiency, and impact on work readiness. Comparable experiences of adapting industry integration to local conditions have been documented in other developing and emerging economies, including work-based learning in Africa, collaboration in emerging-economy systems, regional differences within national systems, and green-skill programs developed with industry (Williams et al., 2021; Srinivasa Rao & Rajeswari, 2023; Sarikaya et al., 2022; Ouyang et al., 2023).

Digital technology and simulation (Strategy 3.4) are held to be particularly promising for the problem of reaching industry facilities in remote areas. As digital infrastructure is extended, geographical distance is made to matter less, and virtual industry experience can be made available even across the more scattered parts of the country.

Strategic partnership models (Strategy 3.3), for their part, must be designed around the fact that the Indonesian economy is dominated by small and medium enterprises. Models that are suited to SMEs, whose individual capacity is modest but whose collective weight is considerable, should therefore be treated as a priority, and lessons should be taken from economies of a similar shape (Hidalgo & Jacinto, 2023).

Block systems and work station rotation (Strategies 3.9 and 3.10) are attractive in this setting precisely because they are flexible, and so they can be fitted to local constraints on resources and on the availability of industry mentors. Because they are modular in character, they can also be taken up gradually, in step with how ready a given institution and its industry partners actually are.

4. Conclusion

This study developed an integrative framework comprising ten implementation strategies for strengthening industry integration in vocational education. The findings indicate that effective implementation depends not on isolated strategies but on their systemic interaction across curriculum development, pedagogy, partnerships, educator capacity, certification, and technological infrastructure. Strategic industry–institution partnerships provide the foundation, while structured apprenticeships, industry simulation, and educator industry experience appear particularly important for improving graduate work readiness. The framework contributes theoretically by integrating Human Capital, Skills Ecosystem, Work-Integrated Learning, Triple Helix, and Boundary Crossing perspectives, and practically by offering guidance for policymakers and institutions. Priority actions include increasing industry participation in curriculum development, embedding nationally aligned certification, expanding educator industry attachments, and developing partnership models suited to small and medium-sized enterprises. Future research should focus on measuring implementation outcomes, adapting global models to local contexts, and ensuring inclusivity and equitable access. Overall, sustainable and responsive vocational education requires a collaborative, context-sensitive, and ecosystem-based approach to industry integration.

Conflicts of Interest

The authors declare no conflict of interest regarding the publication of the paper.

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