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Exploration of the Fashion Vocational College Teaching Resources Output Model Based on PDCA

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Abstract: Within the overarching context of the "Belt and Road" initiative, the imperative for localized technical expertise in the global outreach of China's textile and apparel enterprises is pronounced. Nevertheless, challenges persist within vocational education, including the disjuncture between supply and demand, deficiencies in process oversight, and inadequacies in collaborative efforts. This study, under the guidance of the PDCA quality management cycle theory, integrates global insights with localized practices to architect a refined output model for high-quality teaching resources in the textile and apparel industry within vocational colleges. Through empirical inquiries and comparative assessments, a dynamic cycle mechanism encompassing "planning - execution - scrutiny – enhancement" is proposed to navigate the predicament of haphazard actions in output mechanisms. The objective is to furnish a replicable operational framework for the internationalization of vocational education.

Keywords: PDCA Cycle; Internationalization of Vocational Education; Industry-education Collaboration; Textile and Apparel Vocational Education

1. Background

In the emerging paradigm of the "dual circulation" strategy, the textile and apparel industry has emerged as a crucial focal point for capacity collaboration within the "Belt and Road" initiative. In 2021, the direct investment in countries along this initiative totaled 78.6 billion US dollars, driving a significant surge in demand for technology standards throughout the industry chain[1]. The 2024 *Joint Declaration between China and ASEAN on Enhancing Cultural Exchanges* has underscored a commitment to robust cooperation across all tiers of education, encompassing vocational, technical, and adult education. Furthermore, discussions have commenced on joint initiatives for teacher training and educational collaborations[2]. Projections in the industry indicate that by 2025, the adoption rate of intelligent textile equipment is expected to reach 43%. However, a substantial skills gap of 67% among industrial workers in Southeast Asia underscores the urgent need for enhanced training and development. Noteworthy findings from on-site research conducted by the project team between 2023 and 2024 at training institutions affiliated with the Cambodian Textile, Shoe, and Bag Association have shed light on pertinent issues. For instance, the extended training duration in Cambodia for operating apparel automatic cutting machines, valued at 1.2 million RMB, compared to similar programs in China, hints at operational inefficiencies. This extension is attributed to operators grappling with programming complexities, leading to a limited scope of machine utilization and a high equipment idle rate of 73%. A fundamental challenge lies in the structural conflict between the traditional apprenticeship model and the modular output approach, where 78% of teaching staff in Cambodian vocational institutions rely on experiential workshop-based teaching methods. This trend places heightened demands on the transnational dissemination of vocational education resources. However, Chinese higher vocational institutions encounter a "triple disconnect" when endeavoring to provide high-caliber teaching resources to key regions like Southeast Asia within the Belt and Road Initiative. This disconnect arises from incongruities between curriculum frameworks and the host country's industrial advancement requirements, misalignment between teaching methodologies and overseas employment standards, and a prevailing disparity between quality evaluations and international education norms[3]. In response to these complex challenges, previous research has primarily concentrated on macro-level policy analyses, leaving a notable gap in actionable micro-level

operational models. To address this gap, this paper, anchored in the PDCA cycle theory, delineates a nuanced output model focusing on "target identification - implementation strategies - stakeholder collaboration". This approach aims to bolster the efficacy and universality of vocational education outputs, navigating the intricacies of the international educational landscape with precision and foresight.

2. Literature Review and Theoretical Framework

2.1 Chinese and International Research Progress

2.1.1 International perspectives

International Vocational Education and Training (VET) research focuses on systemic approaches, transferability, and export potential for educational output. By identifying the specific strengths and shortcomings of empirical transfer studies, these inquiries have unveiled the core requisites of educational outputs and put forth recommendations on fortifying future research and evidence-based practices [4]. Research on the Internationalization of Vocational Education and Training (IBBF) projects has scrutinized the "government endorsement + commercial operations" model, occupying over 60% of the Vietnamese market, yet sparking inquiries into educational equity [5,6].

2.1.2. Chinese explorations

In Zhejiang, efforts to promote educational collaborations with Central and Eastern Europe have seen provincial vocational colleges establishing "Luban Workshops" and "Silk Road Institutes" in countries along the Belt and Road, amplifying support for the Belt and Road Initiative[7]. Conversely, Jiangsu Engineering Vocational and Technical College has developed a digital resource package combining "bilingual massive open online courses (MOOCs) + virtual simulation training". However, concerns persist regarding the absence of a robust intellectual property protection mechanism[8].

2.2 Analysis of Theoretical Relevance

The PDCA cycle theory embodies three key adaptive characteristics: ① The closed-loop nature of process control can address the problem of "heavy output, light feedback". ② The sustainability of quality enhancement aligns with the dynamic adjustments required in transnational education. ③ The coupling nature of stakeholder synergy matches the diverse engagement features of "government-industry-school" collaboration, fostering a harmonious and effective alignment for multifaceted participation.

3. Research Design and Methodological Framework

3.1 Tri-dimensional Research Architecture

3.1.1 Demand dimension

The Delphi method was utilized to conduct demand validation in the textile and apparel industries of Myanmar, Cambodia, and other countries, establishing an assessment matrix comprising industry gradients, cultural taboos, educational foundations, and other pertinent indicators.

3.1.2 Supply dimension

The resource repository of the Yangtze River Delta Textile and Apparel Vocational Education Alliance was dissected to distill seven categories of transferable core resources (including bilingual curriculum standards packages, virtual simulation training systems, and more).

3.1.3 Carrier dimension

A curriculum structure of "Chinese + Professional Skills" was crafted, alongside developing teaching implementation guidelines infused with cultural sensitivity.

3.2 Mixed Research Methods

3.2.1 Quantitative research

The operational data from 36 textile and apparel education output projects in Zhejiang Province from 2020 to 2024 were collected. Then, SPSS 26.0 was utilized for regression analysis to validate the impact weights of each PDCA cycle stage on output efficiency.

3.2.2. Qualitative research

In-depth interviews were conducted with 15 HR representatives from multinational enterprises in Myanmar and Cambodia, and Nvivo 12 was employed for three-tier coding to extract core categories such as "local teacher training" and "cross-cultural communication mechanisms".

4. Model Innovation Driven by the PDCA Cycle

The PDCA cycle, consisting of Plan, Do, Check, and Action, perceives quality management as a spiraling progression involving planning, execution, result inspection, and conclusion

processing across four stages. Each iteration addresses issues, achieves outcomes, propels forward, before transitioning to the next loop, updating iteratively, recurring continuously until the overarching goal of quality management improvement is achieved. In educational contexts, this theory is applied to teaching quality management and monitoring [9].

4.1 Plan Phase (P)

Traditional needs analyses often concentrate on technical parameter alignments while overlooking softer elements like cultural cognition. The "Four-Dimensional Diagnostic Matrix" developed in this study facilitates systematic risk anticipation.

4.1.1 Development of host country industry demand map and curriculum standard alignment

By dissecting target country industry standard documents, establishing a mapping of knowledge points in both Chinese and the local language, such as collaboration with the Institute of Standards of Cambodia (ISC), the study identifies technical parameter discrepancies between ICS (Cambodian National Standard code) standards and Chinese standards. This enables targeted development of adaptive curriculum modules.

4.1.2 Faculty competencies

A quantitative evaluation model encompassing "Technical Understanding (40%), Teaching Method Adaptability (30%), Cross-Cultural Communication Skills (30%)" is constructed to predict the efficacy of faculty training. Evaluations of 30 teachers from Myanmar and Cambodia indicate that within the group scoring below 60 points, the risk of training ineffectiveness reaches 81%.

4.1.3 Analysis of compatibility of practical training equipment

Establishing an equipment parameter database and utilizing digital twin technology to simulate equipment operational environments aids in the early identification of compatibility risks. Prior to deployment at the training base in Myanmar, simulations revealed an incompatibility issue between a high-speed sewing machine produced in China and the local grid frequency (50Hz/60Hz), averting equipment damage.

4.1.4 Cultural cognition alignment

The innovative design of the Cultural Tolerance Index (CTI) incorporates Hofstede's cultural dimensions theory, incorporating core indicators such as power distance and uncertainty avoidance for determining dynamic weights via the Delphi method. Application of the CTI index in training in Yangon, Myanmar revealed that when the index falls below 0.6, project failure risks soar to 78%.

4.2 Do Phase (D)

A departure from the traditional school-enterprise binary collaboration model is witnessed during the execution stage, as the innovative three-helix model of "Government-Enterprise-Institution" unfolds.

4.2.1 Empowerment through policies

A mechanism of cross-border credit recognition was established based on the educational service provisions within the RCEP (*Regional Comprehensive Economic Partnership*) agreement. For example, within training institutions affiliated with the Cambodian Textile and Footwear Bag Association, the inclusion of the "Fundamentals of Apparel Sewing" course in the association's vocational qualification framework enabled the mutual recognition of certifications between China and Cambodia, leading to a notable 29% increase in student employment rates.

4.2.2 Capability mapping output

Leading enterprises striving into international markets, such as the distinguished Jiaxin Silk Group, provide models of job competency units, segmented into three core modules: "Equipment Operation (45%), Quality Control (30%), Production Management (25%)". Table 1 below illustrates the competency model for frontline operators in the apparel industry.

Table 1. Competency Model for Frontline Operators in the Apparel Industry

First-level Indicator	Second-level Indicator	Key Behaviors	Evaluation Method
Equipment Operation 45%	1. Proficiency in Operations	- Excellent: Smooth and precise actions, surpassing quotas by far, seamless connectivity. - Qualified: Following standard processes, stable actions, meeting quotas. - Needs Improvement: Clumsy actions with frequent pauses, requiring assistance, unable to meet quotas.	On-site practical assessments, production data statistics

	2. Equipment Setup and Maintenance	- Excellent: Independently and swiftly completing changeovers (e.g., presser feet, needle plates, shuttle cores), anticipating and resolving common faults (e.g., broken threads, skipped stitches), maintaining daily upkeep properly. - Qualified: Completing changeovers under supervision, identifying faults without necessarily solving them, basic maintenance completed. - Needs Improvement: Fully relying on mechanics for setup and fault resolution, weak awareness in maintenance.	On-site observations, equipment fault records, maintenance record checks
	3. Multifunctional Adaptability	- Excellent: Proficiently operating three or more key processes, a versatile production line operator. - Qualified: Mastering operations in their position, able to handle 1-2 neighboring processes. - Needs Improvement: Limited to their position without adaptability to rotational or substitute demands.	Position rotation assessments, skill matrix charts
Quality Control 30%	1. Understanding and Execution of Quality Standards	- Excellent: Deep understanding of quality inspection standards for their own and adjacent processes, capable of memorizing key parameters (e.g., stitch distances, seam widths), and strictly adhering to them at 100%. - Qualified: Understanding quality standards for their own processes, following guidelines when reminded. - Needs Improvement: Unclear standards, operating on intuition, resulting in unstable product quality.	Oral/written exams, on-site compliance checks
	2. Self-inspection and Mutual Recognition	- Excellent: Cultivated a habit of "inspect oneself, confirm by others", self-examining each product immediately after completion, proactively inspecting semi-finished products from upstream processes, promptly identifying and isolating defective products. - Qualified: Conducting scheduled self-inspections, reporting notable issues. - Needs Improvement: Lacking self-inspection awareness, relying on downstream or quality control for defect discovery.	On-site observations, defect traceability records (initial defect sources)
	3. Responding to Quality Issues	- Excellent: Ability to swiftly identify the root causes of common quality issues (e.g., fabric flaws, equipment malfunctions, operational errors), and taking correct measures (e.g., equipment adjustments, reporting to supervisors). - Qualified: Identifying defects but weak in root cause analysis, requiring assistance. - Needs Improvement: Indifferent or only inclined to complain about quality issues.	Simulation scenarios , case studies on quality issue resolution
Production Management 25%	1. Efficiency and Tempo Awareness	- Excellent: Strong sense of rhythm, willingly complying with assembly line tempo, ensuring smooth processes. Willing to work overtime or assist others in bottleneck situations. - Qualified: Completing assigned tasks, but lacking holistic attention to line efficiency. - Needs Improvement: Procrastinating tasks, often becoming bottlenecks in the production line.	Production line balance analysis, team leader evaluations
	2. On-site 6S and Discipline	- Excellent: Workstations maintained tidy and organized at all times, tools and materials arranged neatly, strictly adhering to safety protocols and factory rules. - Qualified: Can organize workstations as required, generally following discipline. - Needs Improvement: Disorderly workstations posing safety hazards, poor discipline adherence.	6S inspection ratings, attendance and discipline records
	3. Team Collaboration and Communication	- Excellent: Actively communicating with upstream and downstream processes, helping new colleagues, reporting production anomalies clearly and accurately. - Qualified: Able to get along with colleagues, engaging in basic communication when needed.	360-degree feedback (team leader evaluations, evaluations from colleagues in

		- Needs Improvement: Closed off, poor communication hindering team cooperation.	upstream and downstream processes)

4.2.3 Resource transformation system

In alignment with the capability mapping, academic institutions employ a flexible structure of modular resource packages, characterized by a combination of "Basic Module (60%) + Country-Specific Adaptation Module (40%)" as illustrated in Table 2. For instance, tailored initiatives include the development of the SES series for knitting equipment operation training projects in Myanmar's knitwear market and the implementation of CNC brocade equipment operation training projects in the Sino-Cambodian Textile Industrial Park.

Table 2. Transferable Core Resources

	Core Resources	Resource Description	Transferable Value
1	Bilingual Curriculum Standards and Packages	Comprehensive teaching solutions including standards for "English+" courses, textbooks (including electronic versions), lesson plans, courseware, teaching case studies, exercise banks, and assessment schemes.	Swift transplantation, standard alignment, addressing the fundamental question of "what to teach"
2	Modular Virtual Simulation Training Systems	Online training platform enabling simulations of clothing design, fabric inspection, 3D fitting, automated cutting, intelligent sewing line operations, factory layout planning, and other high-risk, high-cost, or high-consumption training projects within a virtual environment.	Overcoming hardware constraints, ensuring safety and efficiency, transcending temporal and spatial limitations
3	Industrial Case Study Repository and Skill Competition Resources	Real project cases, typical production processes, quality issue resolution strategies, as well as competition rules, topics, scoring criteria, and outstanding works from national and provincial vocational skills competitions over the years.	Bridging teaching with production, fostering problem-solving abilities through competitions, promoting integrated learning
4	School-Enterprise Collaboration for "Dual-qualified" Teacher Development Resources	Enterprise practice bases, master studios, teacher training packages	Addressing the challenge of "who will teach", establishing a mechanism for continuous teacher growth, promoting talent exchange between schools and enterprises
5	Digital Skill Certification and Credit Banking System	Information technology-based competency certification and credit management system widely recognized within the alliance of enterprises.	Establishing a trustworthy skill passport, fostering lifelong learning, standardizing certification criteria
6	Dynamic Industrial Talent Demand Database	Database on regional textile and apparel industry job demand fluctuations, skills requirements trends, and salary levels.	Serving as a tailored "compass" for program design, an indicator for curriculum updates, and a navigation tool for career services
7	Open Resource Sharing and Collaboration Platform	Online platform and operational mechanism supporting the efficient operation, sharing, and updating of all aforementioned resources.	Providing a technological foundation, constructing a collaborative ecosystem, ensuring resource vitality

4.3 Check Phase (C)

In the check phase, a sophisticated seven-dimensional assessment system encompassing "Pedagogical Design, Technological Application, Cultural Adaptation,

Learning Efficacy, Social Impact, Economic Value, and Ecological Benefits" was established. This system examines the alignment between course objectives and industry needs, tracks graduates' career development paths, transcends traditional singular outcome evaluation models, and achieves objectivity in skill assessment[10]. Innovative in its approach, the system adopted a dynamic weighting algorithm, such as elevating the weight of "Social Impact" to 30% in economically underdeveloped regions and emphasizing the "Economic Value" indicator in industrialized areas.

4.4 Act Phase (A)

A cloud-based teaching service platform should be established to facilitate the timely uploading of key data related to teaching processes, assessment outcomes, and more, ensuring the authenticity of educational quality traceability. This initiative leads to the creation of a standardized repository for improvement schemes, enabling cross-domain knowledge sharing, collaborative problem diagnosis, and the allocation of technical support.

5. Practical Verification and Iterative Enhancement

Empirical Analysis of the "Belt and Road Silk Road College"- Jiaxin Sino-Burmese Garment College in Zhejiang Province

5.1 Demand Customization

Addressing the actual requirements of Myanmar's garment manufacturing industry transitioning towards an ODM (Original Design Manufacture) model, this study developed an advanced curriculum system including "Chinese Plus" courses. Through the establishment of a case study repository and the formulation of a processing workflow involving "Scenario Collection - Pattern Analysis - Solution Generation", 28 typical teaching modules covering areas such as digital transformation of ethnic patterns and qipao production techniques were developed. As a result of implementation, enterprise satisfaction rose to 86%.

5.2 Process Optimization

By engaging in three rounds of the PDCA (Plan-Do-Check-Act) cycle iteration, the study effectively resolved the issue of weak practical skills among Burmese teachers. A teacher training path was established and implemented, involving "Chinese demonstration - Burmese emulation - Joint teaching".

5.3 Model Output

A standardized toolkit was created encompassing six core courses such as *Chinese Plus Garment Production Assembly Line Skills* and *Chinese Plus Garment Sewing Equipment Operation*. This toolkit successfully bridged the gap between the Myanmar garment industry's "centimeter error tolerance" habit and China's traditional craftsmanship concept of "millimeter-level precision".

5.4 Teaching Innovation

A "Scenario-Immersion" teaching model was innovatively adopted, and a dual-channel mediation mechanism was established for resolving "Cultural Conflicts - Technical Differences". This mechanism effectively resolved 87% of international teaching disputes. This model has been validated in 12 textile and apparel vocational education cooperation projects in countries such as Myanmar and Cambodia. Data reveals that the average project implementation period has been reduced by 18%, student skill attainment rate has increased to 89%, equipment utilization rate has reached 82%, and cultural conflict incidents have decreased by 67%. Practice demonstrates that the PDCA cycle provides a systematic solution to overcome the real challenges in vocational education output.

6. Conclusions and Prospects

The PDCA cycle model constructed in this study, by establishing a closed-loop system of "Demand Identification - Resource Development - Dynamic Monitoring - Continuous Improvement", has shortened the average implementation period of high-quality teaching resource output projects by 28% and increased the reuse rate to 75%, thus resolving the practical challenges of internationalizing textile and apparel vocational education. Future research could further explore: ① Establishing a cross-border digital twin training platform ② Improving the overseas school operation risk compensation fund ③ Promoting the development of cross-cultural training scenarios empowered by technology[11]. With the implementation of the education service trade provisions of RCEP, this model can support the global textile industry's vocational education

output towards intelligent and precise directions, providing solutions for vocational education to "go global" that are both characteristic of China and internationally relevant.

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