Research on the Innovation of China-ASEAN Digital Industry-Education Integration Model from the Perspective of the Belt and Road Initiative

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Abstract: *Due to the circumstances of the Belt and Road Initiative, China and the ASEAN countries have different levels of digital infrastructure and talent pools; thus, these endowments are both structural barriers to cross-border industrial education integration and the foundation for cooperation. The three levels of this study are the theoretical basis, the framework and the model. Examine the development of the concept and trends in spatial-temporal reconstruction for the digital economy and education integration, and determine the three levels of integration requirements in China and ASEAN. Next, we will present the supply-demand matching mechanism in the digital age, the process of cross-border data-driven value co-creation, and the non-linear relationship between collaboration density and knowledge transfer efficiency. Finally, there is the generative logic of distributed communities based on digital platforms, a modular curriculum adaptation model, and an adaptive ecosystem with a flexible architecture. Therefore, based on the above studies, the direction of innovation will be to move from linear cooperation to networked symbiosis, and algorithmic trust will replace geographical proximity.*

Keywords: *Belt and Road Initiative, China-ASEAN Cooperation, Digital Economy and Education, Model Innovation, Cross-border Cooperation, Modular Curriculum, Flexible Architecture*

Introduction

The Digital Economy is changing how the industries around the world and schools are being taught now. China and the ASEAN countries have reached different stages in the development of digital technology and thus have different demands; therefore, we need to promote cross-border education in the digital age for both sides to achieve innovation. The old model of industry-education integration is based on geographical proximity and institutional coordination, so it cannot solve the problem of cross-regional imbalance. China has been at the forefront of building digital infrastructure around the world, and ASEAN is relatively spread out internally. Therefore, the matching mechanism for educational resources and the needs of enterprises need to be reformed. Most of the previous research has concentrated on bilateral project-based cooperation and has not systematically studied the cross-border multi-layered structure or developed a model for the innovation path that is both theoretically sound and practically feasible. The theoretical basis of digital industry-education integration is used in this paper to study the matching mechanism, resource-sharing network and collaboration efficiency, and then, to address the theoretical deficiency of model innovation, a distributed community, a modular adaptation model and an adaptive ecosystem are constructed.

1. Theoretical Basis and Regional Adaptation Logic of Digital Industry-Education Integration

1.1 Conceptual Evolution and Main Contents of Digital Industry-Education Integration

The idea of digital industry-education integration began with the spread of information technology and earlier forms of cooperation between education and industry. The first stage of industrial-educational integration was a cooperation model between schools and enterprises in the same area, but there were many obstacles to the effective transfer of resources and updating of knowledge. With the development of digital technology, data elements have become new links connecting the supply of education with the demand from industry, and thus the model of industry-education cooperation has changed from a simple linear alignment structure to a networked collaborative

ecosystem. The three main features of the digital industry-education integration are as follows: First, there is instant availability and wide dissemination of resources; that is to say, digital platforms have removed the space and time constraints on the spread of knowledge. Secondly, the demands for abilities are changing all the time, and with the development of industrial technology and changes in data flow, the teaching content will also need to be adjusted accordingly. Thirdly, there is multi-party participation in value co-creation; that is to say, educational institutions and enterprises are achieving synergistic development in the digital age.

To better understand the main contents of digital industry-education integration, we will study the three levels of structure, process and results. At the level of structure, we will also study the extent of connection in the digital infrastructure, data interface standards, construction of knowledge graphs and scalability of collaborative platforms. At the process level, more attention has been paid to aligning educational content with the needs of industries; thus, course modules have been organised dynamically, the semantics of skill tags have been standardised, and learning progress data have been collected. At the level of outcomes, attention is also paid to the adaptability of the integrated ecosystem and how well the system can respond to changes in technology and demand from the market. The dimensions mentioned above provide an academic basis for education in the digital age and offer a starting point for model innovation in cross-border cooperation[1-3].

1.2 Spatial-Temporal Reconstruction of Cross-border Industry-Education Integration in Light of the Belt and Road Initiative

The geographical scale of the Belt and Road Initiative is very large, and at all levels of construction for digital infrastructure, we need to reconstruct the spatial logic of integrating traditional industries and education. Cross-border industry-education cooperation is no longer limited to project cooperation among institutions in the two countries; now, a distributed network of many nodes and interconnections has been formed. Digital technology has shortened the time lag for the spread of information and reduced transaction costs in cross-border cooperation; therefore, now such cooperation can also be extended to the flow of educational resources across borders. At the same time, there are also structural problems in all the institutions, language systems and industrial standards of the regions that need to be solved by cross-border industrial-education integration. The goal of spatio-temporal reconstruction is to change the actual distance into a reasonable digital scale, and with the help of standard data protocols and modularisation of knowledge, cross-border educational supply can be effectively connected with industrial needs.

Generally speaking, there are three patterns in the spatial-temporal reconstruction of industry-education integration in the cross-border area of the Belt and Road Initiative. First, there will be a distributed distribution of collaboration nodes, and the old model of industry-education cooperation with geographical hubs will be replaced by a multi-centre flattened network. Second, there is compression and expansion in the time dimension; that is to say, real-time interactive technology reduces the response time, and asynchronous learning platforms increase the amount of time students need to study. Thirdly, the border of space has been broken; with the introduction of virtual simulation environments and remote experiment platforms, cross-border industry-education activities can now be carried out without the need to be in the same place. Given the changes above, the operating model of cross-border industry-education integration has been reformed, and all parties involved must clarify their responsibilities in the network and how to share resources.

1.3 Identification of Differences in Digital Endowment and Integration Demands between China and ASEAN Countries

China and the ASEAN countries have different amounts of digital infrastructure, different numbers of digital talents, and various degrees of industrial digitalisation. China has made good progress in expanding the high-speed broadband network and building large-scale data centres and digital payment systems, and the ASEAN countries are at different stages of digitalisation; Singapore and Malaysia have reached a relatively high level of digitalisation, but Myanmar and others are still in the early stages of building digital infrastructure. The first is that we will not be able to promote the cross-border integration of the digital economy and education. To determine the degree of difference in endowments, quantitative analysis should be carried out based on the three dimensions of hardware infrastructure, software application ecosystem and human resource stock to find out the relative positions of all parties on the spectrum of digital capabilities and the types of exchangeable resources.

According to the analysis of endowment differences, the complementary demands of China and ASEAN in the field of digital industry-education integration can be divided into three levels. First, we need to promote the cross-border flow of general training resources for digital skills and standardised curriculum systems. The second stage is to match supply and demand; given that industrial development in various parts of ASEAN countries is at different stages, customised learning modules need to be provided accordingly. The third level is the demand for collaborative innovation, and at this time, the new technology fields are intelligent Internet of Things and edge computing; both sides can achieve knowledge co-creation and capacity co-building through joint research and development platforms. Identify the three types of demand, and then we will put forward a research direction for designing adaptive integration models in the next period and build a tiered and categorised framework for cross-border digital industry-education collaboration[4-6].

2. Multi-Layer Structure Analysis of China-ASEAN Digital Industry-Education Integration

2.1 Matching Mechanism of Educational Supplies and Industrial Demand in the Era of Digital Transformation

With the spread of digital technology, the old mode of coordinating educational supply and industrial demand has changed. Before the development of digital tools, the structure of skills provided by the education system often had a time lag and structural mismatch with the actual needs of the industrial sector due to an excessively long information transmission path and an unstable feedback loop. With the development of digital technology, new ways to collect and analyze data have been introduced, so changes in the industry, required job competencies, new skill shortages in the industry, etc., have all been incorporated into the design of the curriculum and competency development programs at the educational supply end in a near real-time manner. At the bottom of the matching mechanism is a data-driven closed-loop feedback system; that is to say, industrial demand will be turned into quantifiable skill tags and knowledge units, and the educational supply system will dynamically respond to these tags by adjusting the modular curriculum system.

Based on the above analysis of the structure of this matching mechanism, there are three main links in operation. First, there is the link of demand identification; that is to say, based on industrial recruitment information, technical documents and project reports, an organised map of competency demands will be built with the help of natural language processing and semantic analysis technology. Second, there will be a supply-transformation link; that is to say, the educational institutions will conduct a gap analysis of the current course content based on the demand map, find coverage gaps and redundant modules, and adjust the allocation of teaching resources accordingly. Thirdly, in order to collect behavioural data and employment information on the learners, determine how well they are matched, and then use this information for continuous improvement, a matching verification link has been added. Although there are many different languages, the standard systems and data interfaces in all the countries along the China-ASEAN cross-border area have the same basic working principle for this closed-loop mechanism.

2.2 Cross-border Data Flow - Resource Sharing and Value Co-creation in Industry-Education Integration

Cross-border data flow will be needed to share education resources in the digital economy between China and ASEAN. In the old model of industry-education integration, cross-border exchange of educational resources and industrial resources is limited by the mobility of physical carriers and information barriers at the organisational level. Data is a non-rivalrous good with low replication costs, high transmission speed and no depreciation in use; therefore, it has good circulation characteristics in cross-border trade. Standardize the rules for data sharing and build a common-trust data governance system so that educational institutions and enterprises in China and ASEAN can use curriculum materials, experimental data, virtual simulation tools, etc., together in all areas. Sharing can reduce the cost of redundant development and improve the utilisation efficiency and spread speed of resources and knowledge[7].

The other kind of result of cross-border data flow is value co-creation. Joint creation of new knowledge assets and combinations of competencies through data interaction by all parties is called value co-creation, and it is not the same as the one-way transfer of resources. In addition to sharing some basic resources, all parties from China and ASEAN can also make different contributions

according to their own industrial characteristics and educational strengths. For example, one side can provide the basic algorithm course modules, and the other side can add industry application case data; together they will create training content that meets the needs of the industry. The first is a two-way feedback mechanism that will be formed through cross-border data flow; that is to say, the data will carry not only the resources themselves but also information on the results of use, any deviations in adaptation, and necessary improvements. Continue to collect information and learn from all sides to improve the form of resource coordination and build a cross-border collaborative value chain.

2.3 Collaboration Density and Knowledge Transfer Efficiency in a Multi-Actor Network

The China-ASEAN digital industry-education integration is the result of the cooperation of many parties, such as educational institutions, industrial organisations, technology platforms and industry associations. The operating efficiency of this network structure is determined by the collaboration density of the actors; that is to say, it is the frequency and strength of effective information sharing and joint action per unit of time. The Density of Cooperation is limited by the digital literacy of the parties, their interoperability and the development stage of the shared cognitive framework. In a high-density collaboration network, the connection path for actors is short and there is little redundancy; thus, demand information and solutions can be matched through a small number of transmission links to improve the response speed and adaptability of the whole system. A low-density collaboration network will have problems of information silos and idle resources, and the goal of industry-education integration across the whole sector will not be achieved.

The results of knowledge sharing in an organisation are not always good. At a certain level, an increase in the density of cooperation can reduce the path for knowledge transfer from the industrial frontier to the education system and promote the externalisation and structuring of tacit knowledge. However, if the collaboration density is too high, there will be an excessive amount of information sharing; otherwise, people will be overwhelmed by information and have to bear high coordination costs, reducing the efficiency of knowledge transfer. Therefore, in the Design of the China-ASEAN cross-border industry-education integration network, we need to set a suitable level for cooperation. The degree of identification can be judged by how closely organised the knowledge correlations among actors are, by the signal-to-noise ratio of information transmission, and by the complexity of task dependency structures. At the same time, to reduce interaction costs, there are several tiers of collaboration modes, and high-frequency operational coordination can be separated from low-frequency strategic coordination; relatively high levels of collaboration can still be achieved for the effective dissemination of knowledge.

3. Innovation Paths for the China-ASEAN Digital Industry-Education Integration Model

3.1 The Generative Logic of a Distributed Industry-Education Integration Community Based on Digital Platforms

The development of the industry-education integration community in China and ASEAN has been changed by digital platforms. The traditional form of a community is based on geographical proximity and institutional uniformity, so it takes a long time to build trust and establish face-to-face communication. Digital platforms have established a standard interface protocol and traceable management of contribution records to help educational institutions and industrial enterprises in different areas quickly build cooperative relationships and have a short history of cooperation. One of the general features of a distributed community is a decentralized node connection model; that is to say, all participants can be both resources and users, and platform algorithms will automatically connect potential collaborators according to the characteristics of demand and capability tags to reduce the cost of community construction and coordination difficulty[8].

More studies have found the following three reasons for the formation of distributed communities. First of all, the goal of the link is to solve the problems of technology and semantics for participants by offering all-round services of identity verification and data sharing. Second, a trust substitution mechanism will be established; that is to say, the tools of blockchain technology will be employed to record the contribution behaviour and performance data of all parties in the construction of an immutable reputation database, and some of the traditional interpersonal trust will be replaced by algorithmic trust. Thirdly, there is a value-capture mechanism; rules have been set to quantify contributions and distribute benefits so that all parties know how their contributions will be reflected in

the results. The three reasons are to build and operate the China-ASEAN cross-border industry-education integration community in a short time, and its stability depends on the fairness of platform rules and the fault tolerance of the system.

3.2 Design of an Adaptive Model for Modular Curriculum and Dynamic Competency Development

A modular curriculum system can meet some of the many different demands of cross-border industry-education integration in the China-ASEAN region to a certain extent. The old model of a linear curriculum can no longer meet all the demands for digital skills in different countries and areas. A module is an independent part of the knowledge system that can be used alone, and each module has its own learning goals and tests. With the cooperation of China and the ASEAN countries, a cross-border adaptation module has been added to the modular curriculum to find common modules and adjust other modules according to the industrial demand maps of different regions. The general modules can be used and shared across borders, and at the same time, the special modules can be customised according to the industrial characteristics of different areas to meet various demands while maintaining the internal consistency of the knowledge system[9].

The Mode of Adjustment for the Development of Dynamic Competencies is a way to organise the modular curriculum system. At the bottom of this model is the construction of a map showing changes in competency requirements and reorganisations of curriculum modules. Continuously monitor the changes in the demand for skills across all industrial sectors in China and ASEAN, have the model automatically determine the gap vector between the current curriculum combination and the desired state of competence, and then generate corresponding module adjustment plans. The three kinds of changes to the plan are: module addition, which is the addition of new content to replace the old knowledge; module supplementation, which is the addition of missing links in the competency map; and module reorganization, which is changing the order of learning and dependencies among modules. The basis for the adaptation process mentioned above is the actual demand for skills in the industry and analysis of changes in learners' behaviour. The operating accuracy of the model will be reduced by noise in the demand signal and the granularity of module division; both need to be adjusted according to the parameters of cross-border trade.

3.3 Adaptive Evolution and Flexible Architecture of the Cross-border Industry-Education Integration Ecosystem

Therefore, an ecosystem for cross-border industrial and educational cooperation has begun to form in the China-ASEAN area. The components of this ecosystem include educational institutions, enterprises, technology platforms and data banks, etc., and all sorts of interactions among these units are irregular and result in the whole effect of the system. Adaptive evolution is a change in the internal structure and function of a system caused by changes in the environment and feedback signals within that system; it is not the result of external commands. With the development of cross-border trade between China and ASEAN countries, the demand for some types of digital skills has decreased; thus, the frequency of use of the corresponding curriculum module will also drop, and resources will be shifted to areas with higher demand. If the cross-border data channel is busy, another transmission way will be used, or the data compression ratio will be lower. The above evolutionary ability is the result of feedback loops and learning algorithms in the system[10].

The Structure of the above adaptive evolution is built on a weak foundation. The three Design Ideas are as follows: First, redundant Design is employed; that is to say, several copies of the necessary functional part are set up so that if one fails, the system can still operate normally. Second, there is loose coupling; that is to say, the subsystems are connected loosely by a standard interface and can be upgraded or replaced independently. Third, an expandable boundary has been set, and access ports for new types of actors and new types of resources will be added in line with the development of the industry and education in the China-ASEAN region. At random, there will be some disruptions in the ecosystem of cross-border industry-education integration, such as interruptions in data flow, sudden drops in demand or changes in resource supply, but it will still be able to operate normally after these problems are resolved. The speed and accuracy of the recovery process depend on how often it is observed and how sensitive the response mechanism of the system is.

Conclusion

This paper studies the development of innovation in the China-ASEAN digital industry under the education integration model of the Belt and Road Initiative, and an organised system of analysis is provided for the progress of the theory, structure and path design. The three main features of the digital industry-education integration in this paper are the timely sharing of resources, the change in the map of competency requirements, and the value co-creation by all parties. It may also be that decentralisation has declined, the window of time for cross-border cooperation has narrowed, and the scope of this cooperation has been reduced. We will study the closed-loop matching mechanism, the two-way value co-creation process and the non-linear relationship between collaboration density and the efficiency of knowledge transfer in this paper. Therefore, the following sections will present the generation logic of a distributed community based on digital platforms, an adaptive model of modular curricula, and the ideas behind flexible architecture. More research will be carried out to find the threshold of collaboration density, explore the application of distributed ledger technology in reputation systems, and research on the use of edge computing and federated learning for adaptive regulation is also underway. Many-agent simulation can be used to find the range of the disturbance response of a flexible structure.

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References

[1] Fan Zheng. “A Comparative Study on the Follow-Up Cultivation of Dual-Tech Talents and Cooperation between the Industry-Education Integration Community Serving ASEAN under the Belt and Road Initiative.” Public Relations World, no. 8 (2026): 94-96.

[2] Liu Jing. “Research on the Collaborative Innovation Development of China-ASEAN Preschool Education under the Background of Industry-Education Integration.” Industrial Innovation Research, no. 18 (2025): 175-177.

[3] Wu Xueying. “Construction of the China-ASEAN Vocational Education Industry-Education Integration Mechanism.” Industrial Innovation Research, no. 14 (2025): 183-185.

[4] Chen Yangjiao and Yang Li. “Research on the Innovation and Development of Industry-Education Integration in Vocational Education between China and ASEAN.” Journal of Liuzhou Vocational & Technical College, vol. 24, no. 5 (2024): 35-39.

[5] Lu Daxing and Zhang Shuzhi. “Serving the Belt and Road Initiative to Build an International Industry-Education Integration Community.” Educator, no. 22 (2024): 23-24.

[6] Dong Hongjie and Shi Lin. “International Chinese Education and Its Future Development Path from the Perspective of the China-ASEAN Education Community.” Journal of Shaanxi Normal University (Philosophy and Social Sciences Edition), vol. 53, no. 3 (2024): 164-176.

[7] Jia Caixia, Huang Jing, and Rong Yang. “Research on Industry-Education Integration in Guizhou-ASEAN Tourism Vocational Education under the Belt and Road Initiative.” Vocational Education Research, no. 2 (2024): 18-24.

[8] Huang Richeng. “Research on the Internationalization Development of Industry-Education Integration in Vocational Education in Ethnic Regions from the Perspective of the Belt and Road Initiative.” Education and Vocation, no. 4 (2023): 70-75.

[9] Zhang Mengxue and Yang Yuchen. “Research on Cross-Border Industry-Education Integration between China's Yunnan Province and ASEAN under the Belt and Road Initiative.” Journal of Yunnan Normal University (Philosophy and Social Sciences Edition), vol. 53, no. 3 (2021): 111-119.

[10] Zhang Qiufeng and Yang Manfu. “Problem Representation and Promotion Strategies of China-ASEAN Vocational Education Cooperation from the Perspective of the Belt and Road Initiative.” Education and Vocation, no. 7 (2021): 12-18.