

# Research on the Operating Mechanism of Industry-Education Integration Communities from the Perspective of Collaborative Innovation of the “Three Educations”

Bo Jiang

Chongqing University of Technology, Chongqing, China

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**Abstract:** With the deepening of industry-education integration, industry-education integration communities have gradually become an important organizational form for connecting vocational education with industrial development. However, the effectiveness of such communities depends not only on whether schools and enterprises establish formal cooperation, but also on whether teachers, teaching materials, and teaching methods can be jointly developed and continuously innovated. From the perspective of collaborative innovation of the “Three Educations”—teachers, teaching materials, and teaching methods—this paper analyzes the operating mechanism of industry-education integration communities. Drawing on the Triple Helix perspective and the literature on university-industry collaboration, the paper argues that the community should be understood as a networked governance arrangement in which vocational colleges, enterprises, and other relevant actors jointly participate in value creation. On this basis, a four-stage operating mechanism is proposed: joint goal formation, resource integration, process co-creation, and outcome feedback. The collaborative innovation of teachers constitutes the actor foundation, the collaborative development of teaching materials constitutes the knowledge and content carrier, and the collaborative innovation of teaching methods constitutes the process realization mechanism. These three dimensions interact through communication, trust, shared governance, knowledge transfer, and feedback, forming a self-reinforcing cycle of “joint participation–knowledge integration–teaching innovation–performance feedback”. The study contributes a process-oriented framework for understanding how industry-education integration communities operate and provides practical implications for improving their governance and sustainability.

**Keywords:** Industry-education integration, collaborative innovation, Three Educations, vocational education, industry-education integration community, operating mechanism.

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## 1. Introduction

Industry-education integration has become an important approach to improving the adaptability of vocational education to technological change and industrial transformation. In practice, cooperation between vocational colleges and enterprises has gradually expanded from internship arrangements and employment-oriented cooperation to joint curriculum development, teacher training, technological services, and collaborative innovation. This evolution has created a need for more stable organizational arrangements capable of coordinating multiple actors and integrating educational and industrial resources. Industry-education integration communities can be viewed as such an organizational arrangement because they connect schools, enterprises, research institutions, industry organizations, and other stakeholders around shared development objectives.

Existing research on university-industry collaboration emphasizes that collaboration is fundamentally a process of knowledge exchange and organizational coordination rather than a simple contractual relationship [1, 2]. The Triple Helix perspective further suggests that innovation emerges through interaction, communication, negotiation, and role reconfiguration among universities, industry, and government [3]. Empirical studies have also shown that coordinated relationships among innovation actors can improve innovation efficiency, while trust and shared governance are important conditions for knowledge transfer and collaboration outcomes [4, 5]. These insights provide a useful

theoretical basis for examining the operation of industry-education integration communities.

However, existing discussions often focus on institutional cooperation, resource allocation, or governance structure, while insufficient attention is paid to what happens inside the teaching and learning process. For vocational education, the value of industry-education integration ultimately needs to be translated into teaching content, teacher competence, and teaching practice. The “Three Educations” reform—teachers, teaching materials, and teaching methods—provides a particularly useful analytical lens. If teachers remain separated from industrial practice, teaching materials are detached from current production technologies, and teaching methods fail to reproduce authentic work processes, the formal establishment of an industry-education integration community may not generate substantive educational outcomes.

Therefore, this paper focuses on the following question: how does collaborative innovation of the “Three Educations” influence the operation of an industry-education integration community? Based on the literature on collaborative innovation, university-industry cooperation, and the Triple Helix, this paper constructs a process-oriented operating mechanism consisting of goal coordination, resource integration, process co-creation, and outcome feedback. The analysis attempts to move beyond a static description of the community and explain how collaborative relationships are transformed into continuous educational and innovation outcomes.

## **2. Theoretical Foundations and Literature Review**

### **2.1. Collaborative Innovation and the Triple Helix Perspective**

The Triple Helix model explains innovation through the interaction of university, industry, and government. Etzkowitz and Leydesdorff argue that communication and negotiation among institutional partners can generate new organizational arrangements and reorganize existing relationships [3]. The central implication is that innovation is not produced by a single organization in isolation; instead, it develops through overlapping roles, knowledge exchange, and continuous interaction among heterogeneous actors.

Although an industry-education integration community is not identical to a regional innovation system, the Triple Helix perspective is useful because the community also involves multiple actors with different goals, resources, and institutional logics. In vocational education, schools possess educational knowledge, pedagogical resources, and student development capabilities, whereas enterprises possess technological knowledge, production processes, equipment, and labor-market information. Government and industry organizations may provide policy coordination, standards, and institutional support.

The community therefore needs a mechanism that converts heterogeneous resources into shared educational value. This conversion cannot be achieved solely through administrative orders. It requires repeated interaction, negotiation, trust, and shared governance. Research on university-industry collaboration similarly identifies management engagement, continuous learning, real-world problem orientation, and flexible coordination as important collaborative practices [1].

### **2.2. Industry-Education Integration and Knowledge Transfer**

University-industry collaboration literature indicates that knowledge transfer is one of the central purposes of cross-organizational cooperation [1, 6]. Knowledge transfer is particularly important in vocational education because occupational competence is closely related to the integration of explicit knowledge, tacit knowledge, and practical experience.

Enterprises can provide access to emerging technologies and authentic work processes, while educational institutions can transform these resources into teachable and learnable knowledge structures. However, knowledge transfer across organizational boundaries is not automatic. Differences in objectives, professional languages, routines, and evaluation criteria may create barriers.

Bruneel et al. [2] demonstrate that previous collaboration experience and inter-organizational trust can help reduce barriers to university-industry collaboration. Similarly, de Wit-de Vries et al. [6] identify knowledge differences, institutional cultures, trust, communication, intermediaries, and experience as important factors influencing knowledge transfer. These findings suggest that the operation of an industry-education integration community depends on both formal coordination and relational interaction.

### **2.3. The “Three Educations” as a Micro-Level Operating Mechanism**

The “Three Educations” refers here to the coordinated

innovation of teachers, teaching materials, and teaching methods. It is treated not as three independent reform tasks but as three interdependent components of the educational production process. Teachers are the main actors who interpret and implement industrial knowledge; teaching materials are the carriers through which occupational knowledge and technological developments are structured; and teaching methods are the process mechanism through which knowledge is transformed into student competence.

From this perspective, collaborative innovation of teachers means that school teachers and enterprise experts jointly participate in curriculum design, practical teaching, skills training, technological projects, and teacher development. Collaborative innovation of teaching materials means jointly developing work-process-oriented textbooks, digital resources, project cases, technical standards, and enterprise-based learning materials. Collaborative innovation of teaching methods means introducing authentic tasks, project-based learning, workplace scenarios, digital simulation, and other approaches that connect classroom learning with occupational practice.

The three dimensions reinforce one another. Changes in industrial knowledge require new teaching materials; new materials require teachers with corresponding competencies; and new teacher competencies need appropriate teaching methods to be realized. Therefore, the “Three Educations” should be understood as a coupled mechanism rather than three separate reform initiatives.

## **3. Operating Mechanism of Industry-Education Integration Communities**

### **3.1. Joint Goal Formation: From Individual Interests to Shared Value**

The first stage of community operation is the formation of shared goals. Schools and enterprises usually have different immediate objectives. Schools emphasize educational quality, student development, and talent cultivation, whereas enterprises emphasize technological application, production efficiency, and talent availability.

If cooperation remains at the level of loosely connected individual projects, the community may become fragmented. A stable community therefore needs a process of goal negotiation. The core question is not simply what each actor wants to obtain, but what common value can be created through cooperation.

Joint goals may include improving the relevance of talent cultivation, updating occupational standards, developing high-quality teaching resources, solving enterprise technical problems, and strengthening students’ practical competence. Shared goals create a common reference point for subsequent resource allocation and performance evaluation. This is consistent with the Triple Helix perspective, which emphasizes that communication and negotiation among institutional partners can generate new organizational arrangements [3].

### **3.2. Resource Integration: From Fragmented Resources to a Shared Resource Pool**

After shared goals are established, the community needs to integrate heterogeneous resources. School resources include teachers, laboratories, curricula, students, educational platforms, and research capabilities. Enterprise resources include production equipment, technical standards, engineers,

workplace scenarios, technological projects, and market information. Government and industry organizations may contribute policy resources, standards, funding, and coordination.

The key is to convert these dispersed resources into resources that can be accessed and recombined by community members. The “Three Educations” provides a concrete channel for this integration. Enterprise engineers can enter teacher teams; enterprise cases and technical standards can enter teaching materials; production tasks can be transformed into teaching projects; and school teachers can participate in enterprise training or technological improvement.

### **3.3. Process Co-Creation: The “Three Educations” Collaborative Innovation Mechanism**

Process co-creation is the core stage of the operating mechanism. It transforms resource inputs into educational outputs through continuous interaction. First, teacher collaboration should move from occasional enterprise visits to sustained joint participation. Enterprise experts can serve as part-time teachers, mentors, or project leaders, while school teachers can participate in enterprise practice and technological projects. This two-way movement helps reduce the knowledge distance between education and production.

Second, teaching materials should be jointly developed. Rather than treating textbooks as fixed products produced only by educational institutions, the community can organize schools and enterprises to update learning materials according to technological change. Enterprise standards, typical work tasks, production cases, safety requirements, and new technologies can be incorporated into teaching resources.

Third, teaching methods provide the operational interface between teachers, materials, and learners. Project-based learning, task-based learning, workplace simulation, enterprise case teaching, and digital simulation can reproduce authentic work processes in educational settings. Without teachers who understand both pedagogy and industry, and without authentic teaching materials, innovative teaching methods may become superficial. Therefore, the three dimensions should be organized as a coupled system.

### **3.4. Knowledge Transfer and Trust: The Relational Mechanism**

Collaborative innovation requires continuous knowledge transfer between organizations. Explicit knowledge can be transferred through standards, manuals, curricula, digital resources, and technical documents, while tacit knowledge is more dependent on joint projects, observation, mentoring, and repeated interaction. Research on university-industry knowledge transfer shows that organizational procedures and coordination arrangements can either facilitate or hinder knowledge creation and learning [6].

Trust strengthens this process. When schools and enterprises trust each other, they are more willing to share valuable knowledge, disclose practical problems, and invest resources in joint activities. Conversely, low trust may lead actors to protect their own knowledge and prioritize short-term organizational interests. Bstieler et al. [5] demonstrate that shared governance contributes to trust and that trust is associated with knowledge transfer and innovation performance.

### **3.5. Outcome Feedback: From Project Completion to a Self-Reinforcing Cycle**

The final stage is outcome feedback. Community operation should not end when a curriculum, textbook, or training project is completed. Outcomes should be evaluated and fed back into the next cycle. Evaluation indicators may include student competency, employment quality, teacher development, curriculum relevance, enterprise satisfaction, technological application, and innovation outcomes.

Feedback performs two functions. First, it identifies mismatches between educational outputs and industrial needs. Second, it provides evidence for adjusting goals, resources, teachers, materials, and teaching methods. The resulting cycle can therefore be represented as “Shared Goals → Resource Integration → Three Educations Collaborative Innovation → Knowledge Transfer → Educational and Industrial Outcomes → Feedback and Adjustment”. Continuous feedback enables the community to evolve rather than remain a static cooperation platform.

## **4. Integrated Operating Model**

Based on the preceding analysis, the operating mechanism of an industry-education integration community can be summarized as a four-layer process. The first layer is the governance foundation, consisting of shared goals, organizational coordination, institutional rules, and trust. The second layer is resource integration, through which school, enterprise, and other stakeholder resources are recombined. The third layer is the “Three Educations” collaborative innovation layer, including teacher co-development, teaching-material co-development, and teaching-method co-innovation. The fourth layer is the outcome layer, including talent cultivation, knowledge transfer, technological application, and innovation performance.

The four layers are not strictly linear. Governance affects resource integration; resource integration changes the content of collaborative innovation; collaborative innovation generates outcomes; and outcomes provide feedback to governance and goal formation. Therefore, the community should be regarded as a dynamic network rather than a one-time cooperation project. This understanding is consistent with the Triple Helix literature, which emphasizes interaction, negotiation, and evolving institutional arrangements [3, 4].

At the center of this system is the coupling relationship among teachers, teaching materials, and teaching methods. Teachers determine how industrial knowledge is selected and interpreted; teaching materials stabilize and disseminate this knowledge; and teaching methods determine how learners experience and internalize it. If any one element changes, the other two need to adapt. Consequently, the “Three Educations” can function as a micro-level operating mechanism through which macro-level industry-education integration is translated into actual educational practice.

## **5. Discussion and Practical Implications**

First, industry-education integration communities should establish joint governance rather than relying solely on school-led administration. Enterprise participation should extend to goal setting, curriculum design, teacher development, teaching-material development, and performance evaluation. Shared governance can strengthen

ownership and trust, which are important for sustained collaboration [5].

Second, the community should institutionalize two-way mobility between schools and enterprises. Teacher development should include structured enterprise practice, while enterprise experts should receive pedagogical support when entering educational settings. This arrangement can reduce the gap between occupational knowledge and educational knowledge and support continuous knowledge transfer.

Third, teaching materials should be treated as dynamic knowledge infrastructure. Community members should establish regular updating mechanisms so that new technologies, standards, production processes, and typical enterprise cases can be incorporated into teaching resources.

Fourth, teaching methods should be connected to authentic work processes. Instead of simply adding enterprise cases to conventional classroom teaching, communities should design integrated learning tasks in which students solve realistic problems using knowledge and tools derived from industry.

Finally, performance evaluation should reflect both educational value and industrial value. A narrow focus on the number of cooperation agreements or joint projects may encourage symbolic cooperation. A more meaningful evaluation system should examine the quality of teacher collaboration, the updating of teaching materials, the effectiveness of teaching methods, knowledge transfer, student competence, enterprise satisfaction, and sustained innovation outcomes.

## 6. Conclusion

This paper examined the operating mechanism of industry-education integration communities from the perspective of collaborative innovation of the “Three Educations”. Drawing on the Triple Helix perspective and research on university-industry collaboration, the paper proposed a process-oriented mechanism consisting of joint goal formation, resource integration, process co-creation, and outcome feedback.

Within this process, teacher collaboration provides the actor foundation, teaching-material collaboration provides the knowledge carrier, and teaching-method collaboration provides the process realization mechanism. Trust, shared governance, communication, and knowledge transfer connect these elements and enable continuous interaction.

The main theoretical implication is that industry-education integration should not be understood only as an institutional

or resource arrangement. Its effectiveness depends on whether macro-level organizational cooperation can be translated into micro-level educational co-creation. The “Three Educations” provides such a translation mechanism.

This paper is conceptual and does not empirically test the proposed mechanism. Future research may develop measurement scales for the three dimensions of “Three Educations” collaborative innovation, collect data from vocational colleges and enterprises, and use structural equation modeling, qualitative comparative analysis, or case studies to examine the relationships among governance, collaborative innovation, knowledge transfer, and community performance.

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