**Journal of Education and Educational Research**
ISSN: 2957-9465 | Vol. 20, No. 1, 2026

# An Analysis of the Integration Path of Problem-Based Teaching Methods into Logistics Education in Secondary Vocational Schools from the Perspective of Broad Concepts

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**Abstract:** Introducing the problem-based teaching approach into logistics education in secondary vocational schools within the framework of big concepts addresses issues such as fragmented knowledge acquisition, scattered knowledge construction, and inadequate ability transfer among students. Taking "Transportation" from the textbook *Fundamentals of Logistics* as an example, this study integrates it with supply chain system thinking to identify the overarching concept that "logistics transportation is a critical link for efficient, safe, and low-cost spatial movement of goods." Following the six steps of problem-based teaching—creating scenarios, stimulating discovery, formulating hypotheses, conducting group discussions, applying knowledge, and evaluating summaries—the approach provides a practical teaching strategy to facilitate simultaneous enhancement of knowledge and skills as well as coordinated development of professional competence among vocational logistics students, thereby aligning their learning precisely with industry talent cultivation standards.

**Keywords:** Big Concept; Problem-Based Learning Method; Secondary Vocational Logistics Education; Instructional Design.

## 1. Introduction

Under the framework of "new-type productive forces," innovative workers must possess high levels of scientific and cultural literacy as well as strong innovation capabilities [1]. Students majoring in logistics at secondary vocational schools need comprehensive improvement in professional skills, occupational competence, and innovative thinking to cultivate modern vocational professionals who meet corporate recruitment standards and contribute to national economic development. The concept of "big ideas" has been widely adopted to guide educational reform, providing a pathway for implementing core disciplinary competencies. Within this conceptual framework, integrating problem-based teaching into logistics education—using the "Transportation" module from the textbook *Fundamentals of Logistics* as an example—helps address key challenges in foundational logistics instruction, such as a complex knowledge structure, high practical demands, and insufficient cultivation of systematic thinking, thereby enabling students to develop a structured understanding of logistics principles.

## 2. The Intrinsic Value of Problem-Based Teaching Methodology Within the Framework of Big Concepts

### 2.1. The Connotation of Problem-Based Teaching from the Perspective of Big Concepts

#### 2.1.1. The Concept of Big Ideas

The role of big concepts is to strengthen thinking, connect disparate knowledge fragments, and equip students with the ability to apply and transfer knowledge; their essence and value lie in "transfer" [2]. The Compulsory Education Curriculum Standards (2022 Edition) defines big concepts as "concepts or ideas that integrate scattered knowledge, skills, and notions into a coherent whole while endowing them with meaning" [3][4]. This paper posits that big concepts are abstract concepts that provide a comprehensive framework for related disciplinary knowledge points[5], characterized by the following features: First, big concepts represent the integration and refinement of core knowledge; second, they embody the essence of a discipline and its underlying methodologies; third, they facilitate knowledge transfer and foster competency development. Therefore, applying the concept of big concepts to extract core logistics theories in vocational education enables logistics students to better grasp the knowledge network of logistics.

#### 2.1.2. Problem-Based Learning Method

The problem-based teaching method, also known as problem-oriented learning, cultivates students' practical skills, comprehensive application abilities, teamwork capabilities, and self-directed learning skills by designing tasks within open-ended, ill-structured, and complex problem scenarios [6]. Content, activities, context, and outcomes constitute the four key elements of this approach [7]. The problem-based teaching methodology employed in this paper relies on scenario creation and encompasses stages such as inquiry analysis, solution development, collaborative discussion, transfer application, and diversified evaluation. It is a teaching paradigm centered around contextualized and structured professional problems, guiding students to actively construct knowledge, develop professional thinking, and enhance their problem-solving and workplace application competencies when tackling real-world tasks.

#### 2.1.3. Theoretical Consistency Points

The concept of big ideas embodies Bruner's cognitive theory and constructivist philosophy, while problem-based

teaching focuses on real-world problems and integrates elements from Sternberg's constructivist learning theory, Dewey's pragmatist educational theory, and Bruner's discovery learning theory, demonstrating clear theoretical alignment [8]. Introducing problem-based teaching within secondary vocational logistics education through the lens of big ideas aims to address issues such as fragmented knowledge acquisition, scattered knowledge construction, and inadequate ability transfer among students. By using big ideas as the core framework for instructional design and problem-solving as the central thread, this approach restructures the classroom teaching system for logistics education. Grounded in students 'cognitive experiences and closely aligned with real-life contexts and professional scenarios, it enhances students' comprehensive application of specialized knowledge and skills, promotes holistic development, and effectively achieves the educational objectives of logistics studies.

## 2.2. The Value of Problem-Based Teaching Methodology from the Perspective of Big Concepts

### 2.2.1. Macro Level: Supporting Cognitive Systems and Competency Frameworks

Under the framework of big concepts, problem-based teaching in secondary vocational logistics education helps students develop a comprehensive cognitive system and build a structured competency framework. By linking problems to students 'life experiences and future professional contexts while aligning with their cognitive levels, this approach facilitates cognitive leaps that align with Vygotsky's "Zone of Proximal Development" theory. Students actively explore these problems, connecting fragmented knowledge points to construct systematic knowledge networks. Firstly, they gain an overall understanding of logistics industry operations and the relationship between theoretical frameworks and practical applications, thereby developing a deeper and more holistic grasp of the discipline – a hallmark of constructivist learning. Secondly, through solving project-based challenges, students enhance essential skills such as information collection and analysis, problem-solving, and teamwork. The cultivation of these competencies equips students to meet the comprehensive demands of future career development and lays a solid foundation for success in logistics and related fields.

### 2.2.2. Mesoscopic Level: Reconstructing Teaching Procedures and Evaluation Systems

First, traditional logistics education in secondary vocational schools often emphasizes the sequential explanation of knowledge points and a separation between theoretical instruction and practical application. In contrast, problem-based learning centers on specific problems—through methods such as creating real-world scenarios and facilitating group discussions—with questions that closely mirror actual logistics contexts. This approach enables students to learn through active exploration and practice, enhancing their motivation and engagement for learning. Second, while traditional evaluation systems primarily focus on students' knowledge retention and superficial application, the assessment framework under the problem-based teaching model is more comprehensive. It evaluates students across multiple dimensions—including teamwork skills, inquiry abilities, and innovative thinking—emphasizing competency-oriented assessment to holistically reflect learning outcomes and overall student competence.

### 2.2.3. Micro-level: Promoting the Improvement and Enhancement of Subject Teaching

Problem-based teaching within the framework of big concepts can promote the improvement and enhancement of logistics education in secondary vocational schools. This approach requires teachers to regularly update instructional content and integrate cutting-edge industry knowledge and technologies to meet the practical needs and latest developments in the logistics sector. On one hand, the application of guided and heuristic teaching methods not only stimulates students 'learning interest and initiative but also fosters their autonomous learning skills; on the other hand, solving project-based problems helps students gain a deeper understanding of logistics principles, equipping them to tackle future professional challenges and enhance their employability. Finally, through the problem-solving process, teachers can more intuitively identify students' learning difficulties, enabling targeted adjustments to teaching strategies, improvements in instructional methods, and overall enhancement of teaching quality.

# 3. Principles of Logistics Teaching from the Perspective of Two Major Concepts

Teaching within the big-concept framework should be structured around four dimensions: instructional objectives, content, problem-based tasks, and contextual transfer. Using "transportation" as an example from the vocational high school course *Fundamentals of Logistics*, this paper illustrates how to design problem-based teaching approaches under this framework.

## 3.1. Establish Teaching Objectives Based on Training Requirements

A thorough analysis of the talent cultivation requirements for logistics programs in secondary vocational education serves as the foundation for problem-based teaching within this context. Effective instruction requires comprehensive consideration of students' development in multiple dimensions, including the construction of a logistics knowledge framework, mastery of operational skills, and cultivation of professional competencies specific to the logistics industry [9]. In line with the core competency demands of logistics roles such as cargo transportation planning, warehouse management, and logistics information processing, students should acquire essential knowledge—including characteristics of transportation modes, principles of warehouse layout, and applications of logistics information technology—while also developing professional ethics and adherence to industry standards and codes of conduct. Based on these holistic requirements, specific, measurable, achievable, interconnected, and time-bound teaching objectives must be established; only then can they serve as clear targets for instructional efforts, enabling problem-based teaching to precisely address the key competencies required for logistics professionals.

## 3.2. Innovating Teaching Concepts and Developing Teaching Content

Traditional vocational logistics education often emphasizes

the delivery of fragmented knowledge. Problem-based teaching within the framework of big concepts requires educators to fundamentally reform their instructional philosophies and reconstruct the entire curriculum. First, teachers must shift their focus from individual knowledge points to overarching big concepts, using them as a guiding principle for designing instructional content. Second, they should systematically integrate previously scattered logistics modules—such as warehouse management, transportation management, and logistics information technology. Third, instruction should move beyond isolated chapter presentations and instead be structured around real-world logistics projects or problem scenarios. This approach enables students to gradually build a comprehensive logistics knowledge system while understanding the interconnections between different concepts, thereby gaining a deep appreciation of the essence and practical applications of big concepts.

### 3.3. Problem-driven Teaching: Designing Progressive Tasks

Questions serve as the core driving force in problem-based learning. Teachers need to carefully design a series of thought-provoking, challenging, and logically progressive questions tailored to teaching objectives and content. These key questions should stimulate students 'curiosity and desire to explore, guide them toward active and in-depth study of logistics knowledge, encourage consideration of various factors, and subsequently develop advanced tasks based on students' initial reflections and responses. Through this question-driven approach and progression of tasks, students are progressively guided to delve deeper into logistics knowledge, enhance their problem analysis and solution skills, and cultivate logical thinking specific to logistics.

### 3.4. Conduct Tasks Within Specific Contexts to Develop Transferability Skills

The authentic logistics context is essential for gaining a deep understanding of problem-based learning. On one hand, instructors introduce real-world cases from logistics companies and conduct scenario simulations in teaching; on the other hand, students engage in tasks within these contexts, applying their acquired logistics knowledge and skills through practical exercises. Within the framework of big-concept problem-based learning, students not only comprehend and master logistics expertise but also develop knowledge transfer capabilities—enabling them to leverage prior experience to swiftly devise solutions in specific situations. Furthermore, this approach fosters deep learning, better prepares learners for future complex and dynamic logistics environments, and enhances their professional competitiveness.

## 4. Implementation Paths for Problem-Based Teaching of Logistics Transportation from the Perspective of Three Major Concepts

Teaching objectives and content provide a clear visual framework for instruction. Guided by these principles, this section adopts big concepts to organize knowledge and employs problem-based teaching as the instructional approach in the "Transportation" module of the Basic Logistics curriculum at secondary vocational schools.

### 4.1. Goal Setting

In accordance with the professional training objectives and teaching syllabus, students in this unit need to understand core transportation concepts, master transportation processes and elements, and be familiar with relevant regulations and standards; therefore, teaching objectives can be established across three dimensions [9]. At the cognitive level, students should comprehend fundamental transportation concepts, modes of transport and their characteristics, master methods for designing and optimizing transportation processes, and understand related regulations and standards. At the skill level, students will learn to select appropriate transportation modes, design routes, perform cost calculations using tools, and handle transportation documentation. At the literacy level, students will develop safety awareness, environmental consciousness, teamwork spirit, and professional ethics.

### 4.2. Content Establishment

Adopting the big concept approach for problem-based teaching necessitates updating the current logistics education system. This requires teachers not only to thoroughly review existing textbooks but also to draw on other available resources; textbook content must remain dynamic, and educators should identify relevant topics that reflect current economic and social trends for adaptation and refinement [10]. Following resource collection and integration, instructional content should be restructured in alignment with established teaching objectives, ensuring it is well-grounded and systematically organized.

#### 4.2.1. Concept Extraction

Based on the big-concept teaching theory, this study first defined the instructional objectives and, in alignment with the talent development requirements for vocational logistics programs, deconstructed the core components of the "Transportation" module within the *Fundamentals of Logistics* course. By integrating systematic supply chain thinking, it organized the content and refined key concepts. Secondly, considering the cognitive levels of vocational students and their practical job demands, the study delved into the underlying logic of transportation operations to identify a overarching concept suitable for classroom instruction: logistics transportation serves as the critical link for efficient, safe, and cost-effective spatial movement of goods. This concept not only captures the fundamental functions of transportation but also balances practical applicability with professional rigor, encompassing multiple teaching elements—including mode selection, route planning, cost control, and cold chain management—and establishes a central framework for subsequent instructional design, classroom activities, and professional mindset cultivation.

#### 4.2.2. Reorganization Content

Building upon the teaching objective that defines the overarching concept of "logistics transportation as the critical link for efficient, safe, and low-cost spatial goods transfer," and employing a problem-based teaching approach, we systematically reorganized the instructional content in the "Transportation" section of the vocational high school textbook *Fundamentals of Logistics*. This reorganization achieved a structured and practical restructuring of the teaching material guided by this overarching concept. Considering the cognitive characteristics of vocational high school students and the practical requirements of logistics roles, and aligned with the core essence of the concept, we

identified "how to achieve efficient, safe, and low-cost cross-regional spatial goods transfer" as the central instructional question. Using the real-world logistics scenario of transporting Hainan mangoes from local orchards to chain supermarkets in Beijing, we transformed the abstract concept into a concrete, hands-on professional challenge that students could investigate and solve independently, thereby embedding te overarching concept into specific teaching practices.

To address core instructional challenges and overcome the fragmented nature of knowledge delivery in traditional teaching, the transportation module has been integrated into four logically coherent and progressively structured modules. First, optimal transportation mode selection: By considering cargo characteristics, time sensitivity, and cost constraints, students compare advantages and disadvantages of various transport methods—including road cold chain logistics, air cold chain logistics, and combined sea-rail transport—to develop efficient multimodal solutions that meet the core requirements of "high efficiency, safety, and low cost." Second, transportation process optimization and cost analysis: Using cross-regional cold chain transportation of Hainan mangoes as a case study, students systematically examine all operational stages—from cargo collection and route planning to in-transit monitoring and final delivery—while mastering freight pricing rules, cost structures, and route optimization techniques to enhance cost control awareness and process efficiency. Third, risk management and regulatory compliance: Focusing on potential risks such as temperature deviations, route delays, and cargo damage during transportation, students learn emergency response protocols and apply relevant regulations for fresh agricultural product transport to ensure safe operations and regulatory compliance. Fourth, practical application of digital tools: Students master essential operations of GPS-based temperature monitoring systems and TMS (Transport Management System) platforms to achieve efficient control and transparent monitoring throughout the transportation process, thereby improving operational efficiency and safety standards.

These four modules are interconnected through core driving questions and guided by overarching concepts, achieving deep integration of these concepts, key issues, and instructional content. This approach effectively addresses the fragmentation of knowledge points and the disorganization of knowledge structures, enabling students to build a systematic and structured transportation knowledge framework while laying a solid content foundation for subsequent problem-based teaching.

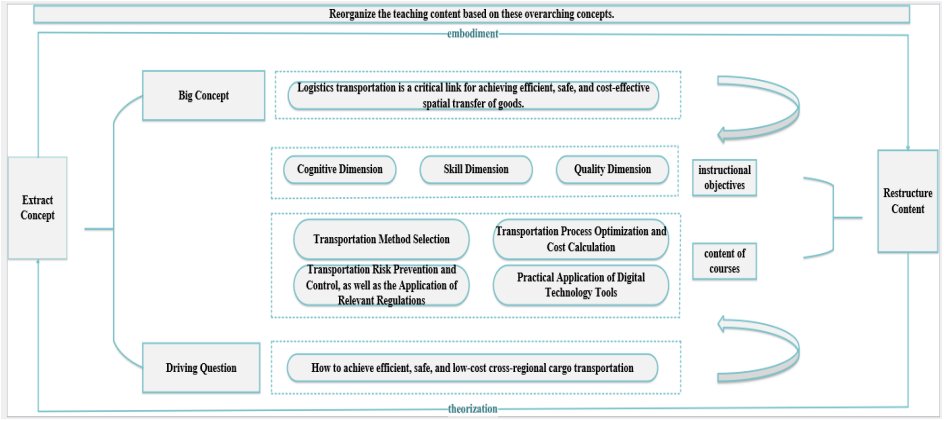


**Figure 1.** Teaching design diagram for the "Transportation" chapter within the framework of a comprehensive conceptual perspective

## 4.3. Implementation of Teaching Methods

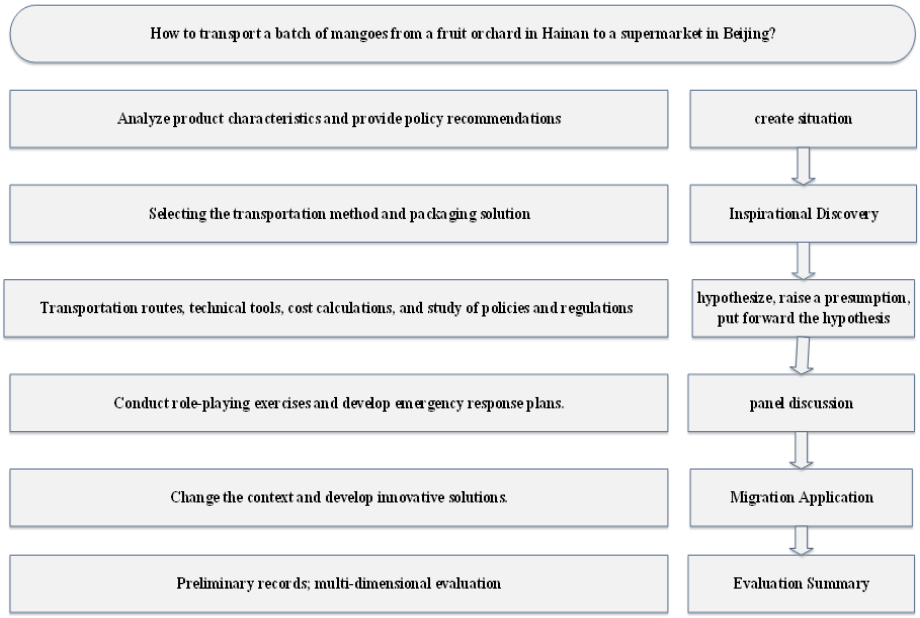


**Figure 2.** Implementation diagram for teaching logistics and transportation problems from the perspective of big concepts

In the actual teaching implementation, it is essential to comprehensively consider the instructional content of all four modules and establish integrated practical tasks. Following the six-step problem-based teaching approach proposed by Hu Jicheng [10] – creating a context, stimulating discovery, formulating hypotheses, conducting group discussions, applying knowledge transfer, and evaluating summaries – this paper develops a teaching design for "how to transport a batch of mangoes from a Hainan orchard to a Beijing supermarket," as shown in Figure 2.

(1) Creating a scenario. Using the industry case of "Hainan mangoes suffering cargo damage and resulting losses of 300,000 yuan for merchants due to transportation delays" as an introduction, this approach aligns with practical job requirements and enhances professional engagement. First, the instructor assigns a core task: students assume the role of logistics company managers and must transport 5 tons of mangoes from Hainan orchards to Beijing chain supermarkets within 48 hours, while meeting constraints including maintaining a constant temperature of 12–15°C, ensuring a cargo damage rate ≤5%, and keeping unit cost ≤3 yuan/kg. Second, students are guided to analyze the biological characteristics of mangoes, integrate the green channel policy for fresh agricultural products, and incorporate principles of compliant operations and green logistics into their analysis.

(2) Inspiration-driven discovery. The teacher presents comparative data on transportation modes and guides students to break down task elements, focusing on three key constraints: temperature control, delivery timeliness, and cost. Through data comparison, students can identify the applicable boundaries of each transportation mode and establish a data-driven analytical framework.

**Table 1.** Comparison Data of Transportation Methods

| way | Temperature Control Capability | Timeliness (Hainan → Beijing) | Cost (RMB/kg) |
|---|---|---|---|
| Road Cold Chain | Standard Refrigerated Truck | 36 hours | 2.8 |
| Airline Cold Chain | Fast but expensive | 8 hours | 4.5 |
| Sea Transport + Railway | The risk associated with temperature control during transit is high. | 5 days | 1.6 |

(3) Formulate hypotheses. Based on data analysis, students developed a transportation plan with the following route: Hainan orchard → Haikou Port (by road refrigerated truck) → Guangzhou Port (by sea refrigerated container) → Beijing (by road shuttle transport), equipped with GPS temperature monitoring devices to enable real-time alerts for temperature anomalies. After conducting relevant cost calculations, they verified compliance with budget requirements. Additionally, in accordance with the Road Transport Regulations of the People's Republic of China, they implemented green channel exemption policies and confirmed that the sea containers met ISO refrigeration standards, ensuring the plan's compliance and feasibility.

(4) Group Discussion. Conduct role-playing exercises in the format of an enterprise project team, assigning roles such as Project Manager, Logistics Coordinator, Cost Accountant, and Risk Controller to collaboratively refine the solution. Address potential risks like typhoon conditions and refrigerated vehicle malfunctions through discussions; utilize the TMS transportation management system to simulate route optimization and develop strategies including nighttime transport routes avoiding high temperatures and GPS-based real-time temperature control alerts. Compare cost and time efficiency to validate the solution's feasibility while simultaneously enhancing practical digital tool proficiency and teamwork capabilities.

(5) Application of Transfer Skills. Teachers modify existing scenarios or create emergent situations, enabling students to apply their knowledge flexibly to solve problems under diverse conditions. For instance, by simulating a real-world scenario where a typhoon causes maritime shipping disruptions, students must develop a transportation plan within two hours and prepare an emergency report outlining cost adjustments and customer communication strategies, thereby effectively enhancing their rapid decision-making and innovative application skills.

(6) Evaluation Summary. Logistics teaching evaluation should emphasize competency orientation, focusing on decision-making skills in real-world scenarios, followed by career integration aligned with job requirements. At different stages of the problem-based learning model, evaluation dimensions vary; a comprehensive assessment mechanism oriented toward competencies should be established, taking into account students 'progress across various aspects. This includes evaluating performance in areas such as contextual thinking, data interpretation, solution design, teamwork, technology application, and transferable innovation. The process should incorporate teacher evaluations, student self-assessments, and peer assessments, implementing differentiated and ongoing evaluations to promote systematic enhancement of students' professional capabilities.

# 5. Conclusion

Integrating problem-based teaching methods into secondary vocational logistics education within the framework of big concepts involves restructuring curriculum content, moving beyond traditional textbook-based instruction. By using big concepts as the cornerstone for instructional organization and leveraging problems to bridge foundational knowledge with advanced concepts through progression from basic to deepening and extended learning, this approach holds significant importance for enhancing teaching effectiveness and cultivating well-rounded logistics professionals. In the future, this philosophy should be further applied to other aspects of secondary vocational logistics education, continuously innovating teaching methodologies and advancing the application of big concept principles in instructional design.

# Acknowledgments

Fund Project: Annual Project of Tianjin Philosophy and Social Sciences Planning (TJGL24-007).


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