

Research on The Practical Pathways and Collaborative Education Mechanism of Interdisciplinary Thematic Learning: Taking The Interdisciplinary Thematic Learning of "China's Bridge" as An Example

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ABSTRACT

The essence of the educational approach is "how to cultivate people," and the reform of educational approaches is currently a focus and key issue in basic education reform. In response to the tendencies of "subject-only" or "de-subject" in teaching activities, interdisciplinary thematic learning, driven by real-world problem scenarios, is implemented. In the meantime, multidisciplinary knowledge and methods are integrated to solve problems, so as to enable students to form interdisciplinary way of thinking and prompt teaching activities from single-subject "isolated efforts" to multi-subject "collaborative education," "from internal subject reform a overall transformation of all-subject education.

KEYWORDS

Interdisciplinary thematic learning; Multidisciplinary; Collaborative education

1 Introduction

The essence of the educational approach is "how to cultivate people," and the transformation of educational approaches is currently a focal and critical issue in basic education reform. "Currently, profound changes unseen in a century are accelerating across the world, a new round of technological revolution and industrial transformation is deepening, the international balance of power is undergoing profound adjustments, and China's development faces new strategic opportunities." The problems and challenges students face in real-life situations are increasingly complex and volatile. The future nation needs comprehensive, versatile, and innovative talents—individuals with "rich inner selves" and "active citizenry" who have grown up under the integration of the "Five Educations" (moral, intellectual, physical, aesthetic, and labor education) and can cope with a complex world and complex events. There is an even greater need for builders and successors of socialism with patriotic spirit, good moral character, social responsibility, and the ability to shoulder the task of national rejuvenation. Consequently, our curriculum must emphasize comprehensiveness and practicality, value the synergistic effect formed by various courses, and build a new pattern of ideological and political education through collaborative education across disciplines.

2 The necessity of interdisciplinary thematic learning

2.1 An important measure for cultivating core competencies

The 2022 edition of the compulsory education curriculum standards clearly states in the course objectives the need to cultivate students' core competencies. The "Compulsory Education Curriculum Plan (2022 Edition)" emphasizes "strengthening the connection between curriculum content and student experience and social life, enhancing the integration of knowledge within disciplines, and designing comprehensive courses and interdisciplinary thematic learning in a coordinated manner." It also recommends that "each subject dedicate no less than 10% of its class hours to interdisciplinary learning."^[1] Most of the 2022 edition compulsory education subject curriculum standards have added "Interdisciplinary Thematic Learning" in the curriculum content section. This signifies that interdisciplinary thematic learning is an important curriculum component for enhancing curriculum integration and collaborative education, and a crucial pathway for cultivating students' core competencies and achieving multi-subject collaborative education.

2.2 An important path for promoting the transformation of educational approaches

The core task of the new round of curriculum reform is to cultivate students' core competencies, and an important path to achieving this goal lies in the transformation of classroom teaching methods and student learning methods. Interdisciplinary thematic learning starts with real-life problems, breaks down barriers between subjects, highlights the internal connections and holistic integration of disciplines, and actively provides students with opportunities to comprehensively understand and apply knowledge creatively to solve problems. This shifts the learning style from "knowledge" (knowledge instillation) to "practical inquiry," the teaching venue from the "textbook classroom" to the "life world," the teacher-student relationship from "teaching and being taught" to "cooperative negotiation," and the educational approach from single-subject "isolated efforts" to multi-subject "collaborative education," providing a new path for realizing the transformation of educational approaches.

3 Implementation model and overview of interdisciplinary thematic learning

In the practice of interdisciplinary thematic learning, we adhere to the fundamental task of fostering virtue through education, base it on subject-based education, and are guided by the school's "Proactive Education Culture." With students as the main body, we consciously explore the comprehensive and practical elements within the subject curriculum, explore pathways and methods for holistic subject education, and promote teaching reform from internal subject reform to a holistic transformation of all subjects. This encourages teachers of various subjects to consciously move from merely completing subject knowledge teaching tasks towards an education-oriented approach, forming a collaborative education community.

Through exploration, we have gradually formed a "Four-Step Research Model" for interdisciplinary thematic learning based on holistic subject education: Determining the Theme, Clarifying Objectives, Task Design, and Evaluation & Reflection. In specific implementation, one subject serves as the main subject. Starting from the knowledge, skills, and methods of this main subject, it actively "crosses" into other auxiliary subjects, utilizing and integrating relevant knowledge and methods from other courses, thereby enabling students to form interdisciplinary understanding and enhance the critical and creative nature of learning. Research themes focus on student interest; learning goals ultimately point towards value guidance; progressive activities are set to cultivate interdisciplinary thinking; and evaluation and reflection are used to stimulate lasting internal motivation. In complex, real-world task scenarios, driven by problems, students autonomously explore and practice, ultimately forming interdisciplinary thinking and achieving spiritual growth.

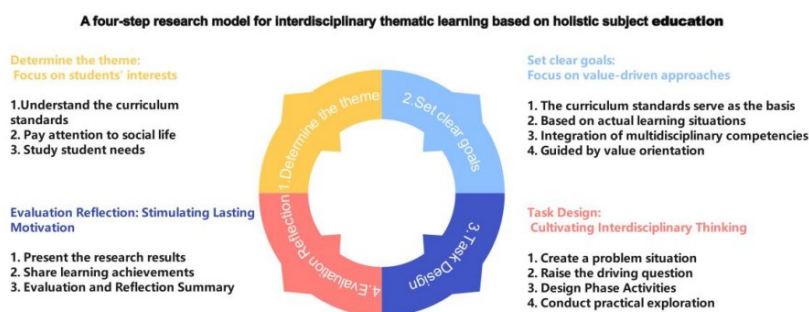


Figure 1 Elaboration on the implementation of interdisciplinary thematic learning

In response to the requirements of the new curriculum and standards, teachers actively promote interdisciplinary thematic learning and explore methods and paths for interdisciplinary learning. However, in practice, issues such as "crossing for the sake of crossing," "crossing without integration," and "integration without depth" arise. Taking the interdisciplinary thematic learning of "Bridges of China" as an example, we use real-life and social scenarios, driven by tasks, to enable students to learn to use multidisciplinary knowledge for exploration and practice to solve problems, forming interdisciplinary thinking that supports lifelong learning. We strive to help students become scientifically minded, spiritually interesting, tastefully noble, and maintain a curious spirit of scientific exploration towards the surrounding world. While forming a holistic worldview, perspective, and methods, they also establish cultural confidence, cultivate national spirit, and stimulate patriotic feelings.

In implementing interdisciplinary thematic learning, we grasp the curriculum standards, pay attention to social life, study student needs, and determine learning themes; base learning objectives on curriculum standards and actual learning situations, connecting multidisciplinary knowledge; create problem scenarios, propose driving questions, design phased activities, and conduct practical inquiry; and finally, present research results, share learning gains, and conduct evaluation, reflection, and summary. Using the "Bridges of China" interdisciplinary thematic learning as an example, we present the process and reflection of curriculum implementation.

3.1 Determining the theme: focusing on student interest

Interest can guide students deep into the palace of knowledge and become the leverage point for exploring and solving complex problems. Theme determination revolves around students' points of interest. The exploration process follows students' problem-solving, and through real connections with the social environment, promotes students' construction of meaningful and memorable experiences during the exploration process.

During a science class, while learning "Interesting Paper Bridges," students discovered that a "paper bridge" made from the same A4 sheet, folded into a corrugated shape, could hold far more weight than a flat A4 sheet. Students wondered: Why does the same width of paper have different load-bearing capacities? Through inquiry, they found that the corrugated paper bears more weight because the folds create many triangles, and triangles are more stable than flat surfaces, able to bear more weight. The teacher then guided them to think: Do you know other items in life related to

triangle force bearing? Students began discussing: Tent poles and supports often use triangular structures to ensure the tent can resist external pressure and not collapse easily; the sides of a ladder, with their rungs and uprights, form multiple triangular support structures, allowing the ladder to bear human weight and remain stable; bridge structures utilize triangular support structures, ensuring the stability and load-bearing capacity of the entire bridge. The teachers in the interdisciplinary thematic learning team realized that the "stability of triangles" learned in math class, the "Zhaozhou Bridge" studied in Chinese class, and "Interesting Semi-circles" in art class could all serve as materials for interdisciplinary learning. Therefore, we decided to conduct an interdisciplinary thematic learning on "Bridges of China," led by science class and supplemented by Chinese, mathematics, labor, art, and other subjects, to explore the history, types, and load-bearing principles of bridges, form research reports, and finally build paper bridges or chopstick (toothpick) bridges.

This theme originates from students' interests and observations, aligns with their cognitive structure and life experience, and satisfies their desire to explore the unknown. Such an inquiry process is more lasting and meaningful.

3.2 Clarifying objectives: pointing towards value guidance

Setting clear, reasonable, and appropriate learning objectives for interdisciplinary thematic learning is a prerequisite for its smooth implementation. It provides guidance for the activities and serves as a reference for evaluation after implementation, ultimately pointing towards the educational value carried by the interdisciplinary thematic learning.

Professor Guo Hua, in her book "What is Interdisciplinary Thematic Learning? How to Do It?", points out that setting goals for interdisciplinary learning should grasp the following basic points: "Use real scenarios closely related to the reality students can access; be able to guide activity development with reasonable and effective driving questions; include necessary subject knowledge points, carrying learning tasks; predict student learning performance, providing reference for evaluation."^[2] Based on the competency performance requirements for interdisciplinary thematic learning in various subjects, the tasks of the interdisciplinary thematic learning, the actual learning situation, and value guidance, we set the goals for this interdisciplinary learning as follows:

(1) Select a bridge of greatest interest, use the internet, videos, books, and other media to collect relevant information about this bridge, understand its history, type, and load-bearing principles, and complete a research report form.

(2) Analyze and compare collected data, understand the load-bearing principles of bridges based on scientific concepts like "structure and function," propose multiple structural models, and communicate. Initially master the process of engineering practice and possess the basic ability to use tools and create physical models.

(3) Apply mathematical knowledge such as triangle stability, ratio, and proportion, as well as learning experiences from art, to solve problems, understand the principles and methods of bridge building, and create and build a paper bridge or chopstick (toothpick) bridge.

(4) In the activities, appreciate the connections between science and Chinese, mathematics, art, labor, and between science and life, initially forming interdisciplinary abilities and interdisciplinary thinking.

(5) Maintain enthusiasm for inquiry, be willing to explore and practice, be good at cooperation, and be willing to share. Cultivate scientific attitude, innovative spirit, and practical ability. Practice the craftsmanship spirit, inherit bridge culture, promote national spirit, and stimulate love for hometown and country.

The setting of interdisciplinary goals is guided by the core competencies cultivated by the curriculum. It includes operationally meaningful goal setting (Goals 1, 2, 3), as well as goal positioning for interdisciplinary thinking (Goals 3, 4), ultimately pointing towards value guidance for students—practicing the craftsmanship spirit, inheriting bridge culture, promoting national spirit, and stimulating love for hometown and country (Goal 5). In summary, the goals of interdisciplinary thematic learning are guided by the core competencies cultivated by the curriculum, translating the quality requirements of the "Three Haves" (having ideals, ability, and sense of duty) into specific learning goals at different levels, thereby ensuring that students gradually form the correct values, essential character, and key abilities needed for personal lifelong development and social development^[3].

3.3 Task design: forming interdisciplinary understanding

Designing appropriate learning tasks can orderly promote interdisciplinary learning. Guided by learning objectives, starting from student development, and supported by learning resources, we design progressive, step-by-step activities.

Task 1: Consult materials to understand the history of bridges.

The teacher uses science class time to organize students to watch videos about the "evolution of bridges" to stimulate learning interest. Create a problem scenario: China is the hometown of bridges. Tianjin has the saying "Nine rivers flow down to Tianjin Wei, three floating bridges, two passes." Tianjin has 73 bridges in total, large and small, each with its own scenery, like a city park themed on "bridges." What other typical bridges are there from ancient times to the present? What culture do they represent? Select a bridge you are most interested in, use the internet, videos, books, and other media to collect information about this bridge, understand its history and type, and complete a research report form.

Task 2: Discover the principles of bridges and skillfully build a "bridge."

Driving question: Why can bridges bear the weight of such heavy cars? What principles do engineers use when

building bridges? Apply scientific engineering practice knowledge, mathematical ratios and proportions, and learning experiences from art to solve problems, understand the principles and methods of bridge building, and create and build a paper bridge or chopstick (toothpick) bridge.

Task 3: Share research results, I am a bridge inheritor.

Share research reports, tell the history of bridges; display and explain the created "bridge."

Through inquiry, the children learned how generations of builders broke through various constraints, even in times of poverty, to create new technologies and achieve leap after leap. They saw how bridges witness the arduous journey our country has taken. Exploring China's four oldest famous bridges—Chaozhou Guangji Bridge, Hebei Zhaozhou Bridge, Quanzhou Luoyang Bridge, Beijing Lugou Bridge—they felt the extraordinary wisdom of ancient working people in China. Sharing the history of the Lugou Bridge and Tianjin's Liberation Bridge, they traversed time and space to relive the unforgettable revolutionary years. Learning about the world's longest sea-crossing bridge—the Hong Kong-Zhuhai-Macao Bridge, the world's longest canyon-spanning suspension bridge—the Aizhai Bridge, the world's highest bridge—the Beipanjiang Bridge, they marveled at the rapid development of modern Chinese technology and the determination to catch up with and surpass the world... By exploring the engineering principles of bridges, mobilizing existing science class cognitive experiences, conducting field investigation and research, personally experiencing and exploring the mechanical principles involved, and hands-on cooperating to complete bridges of different shapes. During the inquiry, one child researched the structure and opening/closing principle of the Tianjin Liberation Bridge online, conducted on-site measurements, and finally, based on the syringe hydraulic principle, built a 1:100 scale model of the opening Liberation Bridge. The children learned how to use hot melt glue for bonding; learned how to use art learning experiences to decorate the "bridge"; learned how to communicate with others, how to cooperate and exchange ideas, and how to share their research results through group discussion, division of labor, cooperation, and sharing.

"Through learning, I understand that a bridge is no longer just a bridge in the substantive sense; it is more of a spirit. I felt the unyielding spirit of the Chinese nation against the invaders when the Qiantang River Bridge was bombed; the determination of our country to be self-reliant when the Nanjing Yangtze River Bridge was completed; the desire of China to desperately catch up with the world when the Shanghai Nanpu Bridge was completed..." said a sixth-grade student. In this interdisciplinary thematic learning, the children not only gained interdisciplinary understanding and formed interdisciplinary thinking but also enhanced their strong sense of national identity, stimulated their feelings of loving their hometown and country, and realized the educational value of interdisciplinary thematic learning.

3.4 Evaluation & reflection: stimulating lasting internal motivation

Timely process evaluation and evaluation of research results during learning can boost students' confidence and stimulate sustainable learning motivation. Summarizing good experiences in interdisciplinary learning in a timely manner facilitates better implementation of interdisciplinary thematic learning.

This interdisciplinary thematic learning used two types of evaluation: process evaluation and summative evaluation. It set three dimensions: individual evaluation, group evaluation, and teacher evaluation, detailing multiple evaluation indicators such as interdisciplinary literacy, inquiry learning, and collaborative communication.

Table 1 "Bridges of china" interdisciplinary thematic learning evaluation table

Evaluation Type	Evaluation Criteria		Star Rating		
	Level 1 Criterion	Level 2 Criterion	Personal evaluation	Group evaluation	Teacher evaluation
Formative	Interdisciplinary Literacy	Able to collect and organize materials according to theme requirements. Able to integrate learned subject knowledge and life experience for analysis and model making.			
	Collaboration	Able to complete assigned tasks within the group, listen attentively to others, actively help.			
	Inquiry Learning	Able to analyze problems, design scientifically feasible inquiry plans, and solve problems.			
Summative	Scientifically Grounded Clear Presentation	The work reflects the research process, is authentic and reliable. Presents learning outcomes clearly and methodically, proposes reasonable suggestions.			
	Artistic	Diverse and creative work forms, able to reflect the characteristics of the investigated "bridge."			
	Profound Reflection	Able to enhance national pride through learning, stimulate love for hometown and country.			

★★★ means "Excellent," ★★ means "Good," ★ means "Average."

This interdisciplinary thematic learning was a student-led inquiry activity with significant autonomy and generativity in the learning process. Evaluation promoted the continuous and in-depth progress of the activities. We adhered to open and diverse evaluation methods. Students developed through self-evaluation, and compared, reflected, and improved through group cooperation.

4 Implementation effects and reflections on interdisciplinary thematic learning

This interdisciplinary thematic learning brought huge changes in learning methods, teacher-student relationships, and evaluation perspectives. It holds certain reference significance for us in optimizing the curriculum content structure under the new curriculum background, breaking down subject barriers, strengthening inter-subject connections, cultivating students' core competencies, and achieving collaborative education across subjects.

4.1 Learning methods: from knowledge transmission to practical exploration

This interdisciplinary thematic learning is student-centered. In completing the tasks, students engage in independent thinking and interdisciplinary integration. In essence, they are able to seek solutions based on real-world problems and apply them in practical contexts.

4.2 Teacher-student relationship: from "teaching and being taught" to collaborative negotiation

In this interdisciplinary learning approach, teachers have shifted from being authoritative knowledge transmitters to becoming learning organizers and coordinators. Through equal dialogue, collaborative inquiry, and mutual inspiration between teachers and students, a learning community has been formed.

4.3 Educational approach: from "isolated instruction" to "collaborative education"

This interdisciplinary thematic learning initiative uses real-life problems as a starting point, breaks down barriers between disciplines, and actively provides students with opportunities to integrate and comprehensively apply knowledge for creative problem-solving, while exploring new collaborative education approaches guided by core competencies.

The case received active participation from students and parents. The results of the interdisciplinary thematic learning were displayed within the school group and received consistent praise from leaders and teachers. In the future, we will take the research model of the "Bridges of China" interdisciplinary thematic learning as a starting point, continuously explore, enrich, and improve new methods for holistic education, providing more possibilities for student growth and school development.

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