

Approaches to Designing Interdisciplinary Theme-Based Learning Cases for Primary and Secondary Schools

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Abstract: Interdisciplinary theme-based learning refers to the instructional arrangement where two or more subject areas are integrated to facilitate learning with the aim of fostering interdisciplinary literacy. This approach is characterized by its comprehensiveness, practicality, inquiry-driven nature, openness, and operational aspects. Interdisciplinary theme-based learning plays a crucial role in cultivating students' interdisciplinary thinking and comprehensive abilities. It also emphasizes the enhancement of problem-solving skills and the facilitation of holistic student development. Moreover, it contributes to fostering innovation and cultivating a lifelong learning attitude. Through empirical research and in conjunction with case studies of interdisciplinary theme-based learning in primary and secondary education, the process of case design can be carried out using six steps: establishing the learning theme, clarifying learning objectives, proposing assessment criteria, arranging learning tasks, implementing the learning process, and promoting summary and reflection. This comprehensive approach ensures the successful implementation of interdisciplinary theme-based learning in schools.

1. Introduction

The "Compulsory Education Curriculum Plan and Curriculum Standards (2022 Edition)" in China explicitly states that schools should allocate no less than 10% of instructional hours for organizing interdisciplinary theme-based learning in each subject. This aims to cultivate students' awareness and abilities to apply knowledge to solve real-world problems. The new version of the curriculum objectives introduces the concept of interdisciplinary education for the first time, directly pointing to interdisciplinary teaching and setting new requirements for it. It emphasizes enhancing collaboration between disciplines, achieving thematic courses, effectively promoting the implementation of integrated courses, and strengthening the demand for practicality. As a result, it emphasizes practical education, interdisciplinary education, and diverse education.^[1]

2. Significance of Interdisciplinary Theme-Based Learning

2.1 Interdisciplinary Theme-Based Learning as a Crucial Vehicle for Developing Students' Interdisciplinary Thinking and Comprehensive Abilities

In the process of students' learning, if various subjects in primary and secondary education remain too fragmented, students often struggle to grasp the interconnectedness of these subjects. They might find it challenging to perceive the practical significance of the knowledge they acquire in a short period, leading to a noticeable decline in their interest in subject-specific learning. Additionally, knowledge might become more abstract and harder to comprehend. This is where the advantages of interdisciplinary theme-based learning come into play.

Interdisciplinary theme-based learning involves integrating content from two or more disciplines to create a thematic teaching arrangement that emphasizes comprehensiveness, practicality, inquiry, openness, and hands-on application. The new curriculum standards emphasize the enhancement of students' overall qualities by emphasizing the integration of individual subject courses, emphasizing the interrelatedness of subjects as a fundamental principle. Through top-level design, comprehensive courses and interdisciplinary theme-based learning are orchestrated to enhance curricular coordination and foster holistic development. This signifies that interdisciplinary theme-based learning serves as a pivotal platform for cultivating students' interdisciplinary thinking and nurturing their comprehensive abilities.

2.2 Emphasis on Enhancing Problem-Solving Skills and Fostering Holistic Student Development through Interdisciplinary Theme-Based Learning

In educational practice, it is imperative to provide students with experiences in interdisciplinary theme-based learning to cultivate their ability to apply knowledge and skills comprehensively to solve real-world problems. This approach also aims to nurture students' interdisciplinary core competencies, enabling them to tackle the increasingly complex challenges of contemporary life. It's crucial to underscore that interdisciplinary theme-based learning does not divorce itself entirely from subject content. Instead, it should integrate relevant knowledge and methodologies from other disciplines, building upon the foundation of subject content, particularly the core knowledge and cognitive approaches.

Interdisciplinary theme-based learning unfolds around a central theme, task, project, or question, facilitating comprehensive learning activities that foster the development of students' interdisciplinary core competencies. The design of interdisciplinary theme-based learning should accentuate the connection between curriculum content, students' experiences, and social life, while also reinforcing the integration between diverse subjects. The shift in perspective is essential, moving beyond the mere combination of simple interdisciplinary knowledge and skills. The focus shifts towards the comprehensive integration of interdisciplinary knowledge and skills, along with their impact on problem-solving abilities and values when addressing real-world issues.

Interdisciplinary theme-based teaching transcends the confines of individual disciplines, utilizing themes as vehicles to break down disciplinary boundaries. It achieves this through a problem-oriented, holistic design and implementation, aligning with the pedagogical philosophy and practice that promotes comprehensive student development. Encouraging students to apply knowledge from various disciplines to address real-world problems within authentic contexts fosters their problem-solving abilities and cultivates a well-rounded worldview, thereby promoting their holistic development. ^[2]Encouraging students to apply knowledge from various disciplines to solve real-world problems cultivates their problem-solving abilities and nurtures a comprehensive worldview, thereby fostering their holistic development.

2.3 Interdisciplinary Theme-Based Learning Fosters Innovation and Cultivates a Lifelong Learning Attitude

Innovation and creativity stand as pivotal factors for modern societal and economic development. Interdisciplinary education provides students with opportunities to explore and learn across multiple disciplinary domains, thereby igniting their potential for innovation. Interdisciplinary curricula break down the traditional boundaries of individual subjects, guiding students to contemplate problems from various dimensions and integrate knowledge from diverse fields to generate novel ideas and solutions. For instance, students engaged in a STEM project might encompass scientific research, engineering design, technological programming, and more, collaborating to integrate knowledge and skills from different subjects, ultimately cultivating their innovation capabilities.

Lifelong learning emphasizes the continuous process of acquiring, updating, and adapting knowledge, skills, and attitudes throughout an individual's entire life cycle, in response to evolving societal and occupational demands. Lifelong learning transcends conventional school-based education, viewing learning as a perpetual, proactive, and self-directed practice aimed at enhancing adaptability, innovation, and engagement. Interdisciplinary courses can spark students' interests in various subjects, nurturing their proactive exploration and learning capacities in new areas, thereby fostering their lifelong learning attitudes. In an interdisciplinary environment, students are more inclined to recognize the interconnectedness of disciplines, prompting them to maintain an appetite for knowledge. For example, an interdisciplinary theme-based course could require students to conduct research on a specific topic from the perspectives of different disciplines, thereby cultivating their ability to actively seek knowledge and explore new domains.

From this, it can be seen that interdisciplinary thematic learning can enhance students' innovation abilities and cultivate their lifelong learning attitudes.

3. Strategies for Interdisciplinary Theme-based Learning

Within the context of interdisciplinary theme-based learning, learning tasks refer to the completion of assigned works, assignments, plans, designs, projects, practical tasks, and other activities related to a specific predetermined theme within a stipulated learning period. Typically, these tasks encompass a core task and several subtasks, forming a group of learning tasks. The essence of learning tasks is to render the questions of "what to learn" and "how to learn" in interdisciplinary theme-based learning easily manageable for teachers. The aim of interdisciplinary theme-based learning is to achieve the integration of both learning content and methods.

By placing learning tasks at the forefront, the conventional barriers between subject-specific teaching are dismantled. This is achieved by catering to problem-solving needs, considering students' age characteristics, and acknowledging the diverse nature of different subjects. It involves merging and reconstructing the structure of interdisciplinary knowledge and skills, embedding interdisciplinary knowledge frameworks, and designing theme-based learning content based on interdisciplinary core competencies. Guided by learning tasks, there is a shift away from the traditional teaching mode of teacher-centered lecturing and student listening. Instead, it explores comprehensive teaching methods such as task-oriented projects, thematic approaches, and problem-solving methodologies, leading to an adjustment in the balance between teaching and learning.

It is essential to emphasize that interdisciplinary theme-based learning is not a dismissal of subject-based learning; rather, it necessitates the use of subject core knowledge concepts as a foundation for conducting comprehensive and in-depth learning. This approach aims to avoid superficial learning and strives to foster substantial engagement. Furthermore, interdisciplinary theme-based learning is not only a blend of subject-based and interdisciplinary learning but also

necessitates considerations of collaborative and coordinated teaching across disciplines. Teachers of different subjects can allocate responsibilities reasonably, ensuring that interdisciplinary theme-based learning does not become redundant or repetitive.

4. Implementation Path of Interdisciplinary Theme-based Learning Units

Interdisciplinary theme-based learning is not a negation of subject-based learning; rather, it necessitates anchoring on the core knowledge concepts of subjects to engage in more comprehensive and advanced depth of learning. It aims to avoid the superficial aspects of interdisciplinary theme-based learning, such as being merely a collection of subjects without depth. Thus, it requires meticulous and profound design. The design of interdisciplinary theme-based learning units typically follows six steps: establishing the learning theme, clarifying learning objectives, setting evaluation requirements, arranging learning tasks, executing the learning process, and fostering learning conclusions and reflections.^[3]

Table 1: Resources from Various Disciplines for "Energy in the Natural World"

Subjects	Core Knowledge Framework	Problem Chains	Learning Resources
Physics	Basic concepts of energy, forms and transformations of energy, types of energy such as thermal energy, kinetic energy, potential energy, and the law of energy conservation.	How is energy defined? How does energy transform between objects? What is the relationship between kinetic energy and potential energy? How can the law of conservation of energy be explained?	1. Textbooks and learning materials, including relevant chapters from subjects such as physics, chemistry, and biology. 2. Experimental and demonstration videos, showcasing real-life processes of energy transformation and transfer.
Chemistry	Energy changes in chemical reactions, storage and release of chemical energy, processes of converting chemical energy into other forms of energy.	In chemical reactions, how does energy transformation occur? What is the relationship between the rate of chemical reactions and energy? How can chemical energy be utilized for energy conversion?	Simulation software or virtual experiments, allowing students to experience energy conversion processes firsthand. 3. Research papers and popular science articles, introducing technologies and environmental impacts related to energy extraction and utilization.
Biology	Energy transfer and transformation within living organisms, energy flow in ecosystems, energy exchange through processes like photosynthesis and cellular respiration.	How is energy transferred and transformed within living organisms? What is the relationship between photosynthesis and cellular respiration? How does energy flow within ecosystems impact ecological balance?	4. Field trips and hands-on experiments, enabling students to directly participate in observing and analyzing energy transformation. 5. These resources will assist students in gaining a comprehensive understanding of various aspects of energy in nature, and explore the essence of energy and its significant role in the natural world from a multidisciplinary perspective.
Geography	Distribution of various energy sources on Earth, extraction and utilization of energy resources, environmental impacts of energy sources.	Which regions on Earth have abundant energy resources? What are the various methods of extraction and utilization for different energy sources? What are the environmental and societal impacts of energy utilization?	

The first step involves determining the learning theme. Interdisciplinary theme-based learning

can directly adopt themes provided in curriculum standards or textbooks. Alternatively, themes can be designed to be more relevant to students' real-life situations. While selecting or creating themes, it is essential to consider various factors, including students' experiences, social backgrounds, and subject foundations. This helps to clarify the nature, categories, and levels of the theme, thereby facilitating the integration of core knowledge frameworks and problem chains from primary subjects and related subjects. This integration process allows for the compilation of a resource list for learning. For instance, consider the theme "Energy in the Natural World," which spans across multiple subjects like physics, biology, chemistry, and geography. The core knowledge framework, problem chains, and resource list pertinent to this theme are illustrated in Table 1.

The second step involves clarifying the learning objectives. Centered around the interdisciplinary theme of study, with the student as the focal point, the objectives are expressed in an integrated manner, encompassing the dimensions of knowledge and skills, processes and methods, as well as emotional attitudes and values. These objectives specify how students will acquire comprehensive learning experiences, core knowledge, and cognitive approaches through various pathways, tasks, or methods, and establish particular emotional attitudes and values as part of their holistic qualities. Drawing from the core knowledge map of the theme "Energy in Nature," the three-dimensional objectives that integrate various subjects and chapters are determined and clearly articulated to define the learning goals of this interdisciplinary theme.

The third step is formulating assessment requirements. The evaluation process for interdisciplinary theme-based learning should be positioned closely to the learning objectives to effectively guide the learning process. While aligned with the objectives, assessment requirements need not cover every aspect but should primarily employ performance-based evaluation methods. The emphasis lies on evaluating students' comprehensive learning and application of core subject knowledge, aiming to target their interdisciplinary core competencies. Using the theme "Food Chain and Healthy Diet" as an example, performance-based assessments can encompass the following aspects: (1) Designing Nutritional Menus: Students need to create a balanced nutritional menu containing various food types based on the principles of the food chain and healthy eating. (2) Food Intake Analysis: Students can analyze their daily diet, calculate the intake of different nutrients, and compare it with healthy eating recommendations. (3) Interpreting Food Labels: Students should select a food product, analyze the nutritional information on its label, and determine if it aligns with healthy standards. (4) Oral Presentations: Students will orally present the position of a specific food in the food chain and its impact on health in the classroom. (5) Process-based assessment can be accomplished through investigating food sources, creating food web diagrams, and conducting nutrient calculations. Students can research the origin of a particular food in the food chain, including its growth, harvesting, and processing processes. They can also create a food web diagram illustrating the production, processing, distribution, and consumption stages of the food. Additionally, students can calculate the nutritional requirements for a specific age group and analyze the types and amounts of food needed to meet those requirements. Summative assessment can be achieved through the following approaches: Firstly, writing a comprehensive review paper summarizing the relationship between the food chain and a healthy diet. This paper can cover the roles of different foods in the food chain, the importance of a healthy diet, and more. Secondly, designing a teaching plan. Students can create a healthful eating teaching plan for peers or the community, including lectures, interactive activities, and more.

The fourth step is to arrange learning tasks. Using the strategy of thematic task-based learning, design tasks, assignments, projects, designs, and other specific requirements that meet the interdisciplinary theme's needs. These tasks should form a core task along with several subtasks. For example, consider the interdisciplinary theme of "Cultural Diversity and Social Integration." For the core task, you can set it as exploring how cultural diversity promotes social integration and

cultivating students' cross-cultural understanding and cooperation abilities. Subtasks can be designed as follows:(1)Analyzing Cultural Impact: Students research and analyze the influence of different cultural backgrounds on individuals and society. They discuss how education can transmit and respect diverse cultural knowledge, values, and traditions. They can create a presentation or video to share their findings.(2)Globalization and Local Culture: Students discuss the relationship between globalization and local culture. They analyze the impact of global culture on local culture and consider strategies to protect and preserve local culture in the context of globalization. Students present their thoughts in a mind map format.(3)Cross-Cultural Communication: Students research how cultural differences impact cross-cultural communication and cooperation. They explore effective strategies for cross-cultural communication, design a cross-cultural cooperation project, and promote collaboration and communication among students in a multicultural environment. By setting up these tasks, students will engage in comprehensive learning experiences that integrate multiple disciplines while addressing the core theme of cultural diversity and social integration.

The fifth step is to initiate the learning process. Integrate the thematic tasks into the learning sessions and processes, progressing sequentially within a defined timeframe. Incorporate the problem chains, knowledge maps, resource lists, and other learning support elements throughout the process. Conduct activities such as self-directed learning, group discussions, and presentations as needed. During this phase, teachers should effectively utilize the core knowledge and thought methods of the main disciplines to construct the learning framework using problem chains, thereby driving interdisciplinary thematic learning. For instance, taking the theme "Energy in Nature" as an example, teachers can leverage the problem chains outlined in Table 1 to guide the learning process, starting from the core knowledge of each discipline. Based on the allotted class hours and resource list, teachers can design structured teaching problems in a progressively deeper manner to facilitate student learning. They can formulate a 4-week series of teaching problems centered around the question, "How to understand and apply energy in nature?" These teaching problems could include:(1)Fundamental Concepts of Energy: What are the basic concepts of energy, and how does energy manifest in the natural world?(2)Solar Energy in Ecosystems: Explore the role of solar energy in ecosystems, how it supports food chains and ecological balance.(3)Energy Resources: Discuss fossil fuels, renewable energy, their acquisition, utilization, and impacts.(4)Renewable Energy Technologies and Storage: Investigate technologies related to renewable energy and energy storage.(5)Environmental Implications: Examine the impact of energy development and utilization on the environment, including climate change, air and water pollution. By structuring the learning process in this way, students will engage deeply with the interdisciplinary theme and develop a holistic understanding of energy in nature.

The sixth step involves promoting learning summary and reflection. The process of learning summation and reflection is a crucial and strategic component of interdisciplinary thematic learning. It serves as a pivotal pathway for students to structure their interdisciplinary knowledge. To facilitate this process, educators need to provide a framework for learning summation. This framework can encompass various aspects, such as thematic content and formats, cognitive approaches, learning experiences, interpersonal interactions, emotional perspectives, spiritual dimensions, and comprehensive qualities. These aspects can be incorporated into written or verbal summaries, both at an individual and group level, helping students cultivate reflective skills and continually enhance their abilities and proficiency in interdisciplinary thematic learning. Firstly, students should engage in the summation of their learning outcomes. They should articulate the new knowledge, skills, and experiences they have gained through interdisciplinary thematic learning. This process encourages students to revisit the core concepts, interdisciplinary connections, and practical instances covered throughout the course. Emphasis should be placed on highlighting significant discoveries and understandings they have made. Educators can also employ written or

verbal summaries that encompass the thematic content, cognitive approaches, learning experiences, interpersonal interactions, emotional perspectives, spiritual dimensions, and comprehensive qualities, in order to facilitate comprehensive reflection. Secondly, students should evaluate their personal growth throughout the learning process. This evaluation includes recognizing their strengths, acknowledging areas for improvement, and noting the progress they have achieved. Students should contemplate whether their cognitive approaches have expanded and whether they have developed enhanced problem-solving and interdisciplinary thinking skills. Thirdly, reflection on learning strategies is essential. Students should consider the strategies they employed during their learning journey, such as reading methods, note-taking techniques, and collaboration within teams. They can reflect on which strategies were most effective for interdisciplinary learning and identify those that might require adjustments or improvements. Fourthly, students should ponder the application and significance of the acquired knowledge and skills in real-life contexts. This involves contemplating how insights gained from interdisciplinary learning can be applied to real-world issues and how they can contribute to their own future development. Fifthly, students should explore their prospective development within the interdisciplinary domain. They can discuss their interests and potential directions for further exploration, whether in academia, professions, or society. This consideration encourages them to deeply engage with interdisciplinary subjects and potentially pursue advanced research and practices. Lastly, students should offer suggestions and feedback regarding course design, teaching methods, and learning resources. This input is valuable for enhancing future interdisciplinary learning experiences, making them more effective and enriched.

5. Conclusion

Interdisciplinary thematic learning is an important approach to fulfilling the fundamental task of cultivating moral character and educating people. It represents a new form of instructional organization that aligns with the orientation of fostering competencies in the context of the new curriculum standards. Interdisciplinary thematic learning serves as a crucial avenue for nurturing students' interdisciplinary thinking and comprehensive abilities. It also emphasizes the enhancement of problem-solving skills and the promotion of students' holistic development, thereby contributing to fostering innovation and cultivating an attitude of lifelong learning. By following the approach of establishing learning themes, clarifying learning objectives, proposing assessment requirements, arranging learning tasks, conducting learning processes, and facilitating learning reflection, the design of interdisciplinary thematic cases can be carried out to effectively advance the successful implementation of interdisciplinary thematic learning.

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