

Original Paper

Research on Interdisciplinary Project Teaching in High School Physics Oriented toward Core Competencies

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Abstract

With the deepening of the new curriculum reform, the development of students' core literacy has become the core goal of high school physics teaching. Based on the teaching practice, this paper systematically combs the practical difficulties faced by high school physics interdisciplinary project teaching in the aspects of curriculum design, teaching implementation, teacher support, and evaluation mechanism, and puts forward targeted countermeasures from the dimensions of teaching concept update, curriculum resource integration, teaching mode innovation, and evaluation system reconstruction, so as to provide reference for front-line teachers to effectively carry out interdisciplinary project teaching and implement the cultivation of physics core literacy.

Keywords

core literacy, High school physics, Interdisciplinary, Project teaching, countermeasure

1. Introduction

The physics curriculum standard for senior high schools (2017 edition, 2020 Revision) clearly puts forward that physics teaching should aim at cultivating students' four core qualities of physics concept, scientific thinking, scientific inquiry, scientific attitude and responsibility. However, the traditional teaching mode based on subject division and teaching is difficult to support students' comprehensive use of knowledge and problem-solving literacy development in complex real situations, and the transformation of teaching methods is imminent.

Interdisciplinary project teaching provides an effective path for literacy implementation by designing real problems or tasks that integrate multidisciplinary knowledge, guiding students' integrated learning in inquiry practice. However, the current practice is facing many challenges, such as tight class hours, lack of teachers, lagging evaluation and so on. How to effectively design and implement interdisciplinary projects based on the reality of high school teaching has become a key issue to

implement the concept of the new curriculum standard. This paper focuses on high school physics teaching, based on the analysis of the current situation, discusses the main problems, and puts forward corresponding suggestions.

2. Current Situation of Interdisciplinary Project-Based Teaching in High School Physics

2.1 Continuously Increasing Teaching Demand

With the transformation of educational philosophy from knowledge-based to literacy based, there is an increasingly urgent need for teaching models that can promote students' comprehensive application and innovative practice. Because interdisciplinary project teaching naturally integrates multidisciplinary knowledge and thinking such as science, technology, engineering, mathematics and even humanities and Arts in solving real problems, it has become an important carrier to cultivate students' core literacy, especially scientific inquiry and scientific attitude responsibility. From national curriculum reform documents to local teaching and research activities, project-based and interdisciplinary learning is encouraged, and teaching exploration is increasingly active.

2.2 Preliminary Exploration of Practical Models

In terms of teaching organization, some schools try to integrate interdisciplinary projects into research-based learning, school-based courses or community activities, led by physics teachers and guided by teachers of technology, mathematics, geography and other disciplines. In terms of teaching methods, explore the "micro project" based on the real situation, such as designing the "roller coaster model design and optimization" project in the "mechanical energy conservation" unit, integrating physics, mathematics and engineering principles. Some regions actively use information technology and introduce virtual simulation experiments and data analysis tools to support the complex inquiry process.

2.3 Growing Emphasis on Administrative Support

Some education management departments and schools began to pay attention to interdisciplinary teaching, and promoted it by setting up interdisciplinary teaching and research groups, organizing special training, and organizing project learning case evaluation. Some schools try to adjust the class hour arrangement, provide flexible time for long-term project learning, and gradually form an attempt to combine "discipline conventional teaching+interdisciplinary project practice".

3. Main Existing Problems

3.1 Insufficient Teaching Design and Implementation Capability

The ability of teachers is the core issue that restricts the effective development of interdisciplinary project teaching. On the one hand, there is a serious shortage of teachers with interdisciplinary curriculum design ability. Most physics teachers are limited by a single subject background and lack professional training to systematically integrate multidisciplinary knowledge and design driven problems. On the other hand, the management ability of project teaching process needs to be improved.

Project learning is open and uncertain. Teachers' experience in role transformation (from lecturer to guide), process guidance, resource support and other aspects is insufficient, which leads to the project easy to become a mere formality or die prematurely.

3.2 Weak Support from Curriculum and Resources

Interdisciplinary project teaching lacks the support of stable curriculum resource system. First, it is difficult to guarantee class hours. The existing subject based curriculum system and fixed class hour arrangement are difficult to support long-term projects requiring continuous and flexible class hours. The second is the lack of supporting resources, and the lack of high-quality interdisciplinary project case library, study manual and evaluation tools that meet the requirements of curriculum standards. Teachers need to develop by themselves, with heavy workload and uneven quality. The third is the limitation of practice site and equipment. Many projects involve production, experiment and investigation, and have high requirements for laboratories, workshops and off campus resources, which are often difficult for schools to meet.

3.3 Inefficient Collaboration and Evaluation Mechanisms

Effective interdisciplinary teaching depends on close teacher collaboration, but the mechanism is not smooth. There are barriers among subject teachers, and there is a lack of institutional guarantee and incentive measures for collaborative lesson preparation and cooperative teaching. Physics teachers often "fight alone", and it is difficult to obtain substantive support from teachers of other disciplines. At the same time, the evaluation mechanism is seriously lagging behind. The traditional paper and pencil test can not effectively evaluate the students' high-level literacy such as the inquiry process, practical ability and cooperative spirit in the project. The lack of scientific process and performance evaluation scheme leads to vague teaching orientation and lack of motivation for students' participation.

3.4 Deviation in Conceptual Understanding

Some managers and teachers have deviation in understanding the value of interdisciplinary project teaching. Or think it is "extracurricular activities", which is opposite to the main subject study and impacts the college entrance examination; Or simply equate it with "handmade" or "lively activities", ignoring the depth of the subject concept and the development goal of thinking behind it. This cognitive deviation leads to the "formalization" or "Marginalization" of teaching practice.

4. Countermeasures and Suggestions

4.1 Strengthening the Development of Faculty Competence

Improving teachers' interdisciplinary project teaching ability is the key. A normalized training mechanism should be established to help teachers master the core skills of project design, process guidance, evaluation design and so on by adopting the mode of "theoretical research+case workshop+practical exercise". Actively establish an interdisciplinary teaching and research community, regularly carry out joint lesson preparation and teaching observation, share experience and solve problems. Teachers are encouraged to participate in research on relevant topics to promote teaching

through research.

4.2 Developing and Integrating Curriculum Resources

Systematic development of interdisciplinary project curriculum resources linked to curriculum standards. Educational research institutions can organize experts and front-line teachers to develop a number of demonstration project cases around the concept of physics and form resource packages. Schools can combine local resources to develop characteristic school-based projects. Explore flexible class hour management, such as the use of “continuous course scheduling”, project learning week and other ways to ensure project learning time. Actively utilize social resources, cooperate with science and technology museums, universities and enterprises, and expand practice bases.

4.3 Innovating Collaborative Evaluation Mechanisms

Break the barriers between disciplines and evaluation, and establish a mechanism of collaborative education and comprehensive evaluation. At the school level, we should establish a system to encourage teachers’ interdisciplinary cooperation, which should be reflected in performance appraisal and professional title evaluation. At the evaluation level, we should build an evaluation system oriented to the development of core literacy, and design multi-dimensional evaluation gauges including scheme design, exploration process, achievement quality, collaboration and communication. Implement portfolio assessment, record students’ growth process, and incorporate project learning results into students’ comprehensive quality assessment.

4.4 Deepening the Reform of Teaching Models

Steadily promote teaching reform from point to area. Start with the appropriate chapters in the required courses (such as “energy”, “fluctuation” and “Application of Newton’s law of motion”), and design “micro projects” with moderate class hours to accumulate experience. Gradually expand to elective courses or special research, and carry out more comprehensive and open projects. Make full use of information technology, simulation software, data collector, online collaboration platform and other tools to reduce the difficulty of project implementation and enhance the depth of exploration. Strengthen the connection between the project and the core concepts of the discipline, and ensure that the project learning can deepen students’ understanding of the concept of physics, rather than breaking away from the essence of the discipline.

5. Conclusion

The interdisciplinary project teaching of high school physics under the guidance of core literacy is an important way to promote the reform of teaching methods and implement the fundamental task of cultivating morality. At present, the practice still faces many challenges in terms of teachers, resources and mechanisms. It is necessary to gradually build an effective mode to support the normalization of interdisciplinary project teaching through systematic teacher training, curriculum resource development, collaborative mechanism innovation and evaluation system reform. Only in this way can we transform the cultivation of core literacy from idea to vivid teaching practice, and truly improve students’

comprehensive scientific quality and problem-solving ability.

References

- Ministry of Education of the People's Republic of China. General High School Physics Curriculum Standard (2017 Edition, Revised in 2020). (2020). Beijing: People's Education Press.
- Xia, X. M. (2018). *Project-Based Learning Design: International and Local Practices from the Perspective of Learning Literacy*. Beijing: Educational Science Publishing House.
- Wang, J. G., & Zhang, H. Y. (2019). Transformation of Senior High School Physics Teaching from the Perspective of Core Competencies. *Curriculum, Teaching Material and Method*, 39(4), 102-107.
- Liu, J. F., & Zhong, Z. X. (2002). A Study on Project-Based Learning (PBL) Model. *Studies in Foreign Education*, 29(11), 18-22.
- Luo, W. X. (2026). Design and Practice of Interdisciplinary Thematic Learning of Senior High School Chemistry Oriented by Core Competencies—Taking “Exploring Carbonated Drinks” as an Example. *Asia-Pacific Education*, 2026(01), 65-68.

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