The Journal of Education Insights Vol 3 Issue 4 2025

Original Research Article

Open Access

Omniscient Pte.Ltd.

Analysis of Innovation in High School Physics Teaching Under the Background of the New College Entrance Examination

Wen-Na Li*

Haiyuan Senior High School, Zhongwei, Ningxia, 755000, China

***Correspondence to:** Wen-Na Li, Haiyuan Senior High School, Zhongwei, Ningxia, 755000, China, E-mail: 2220636919@qq.com

Abstract: The reform of the "New College Entrance Examination" (NCEE) has imposed higher requirements on high school physics teaching, rendering traditional pedagogical models insufficient for the talent cultivation needs of the new era. By deeply analyzing the alignment between the core concepts of the NCEE reform and the characteristics of physics as a discipline, this paper explores the current challenges and opportunities facing high school physics education. Research indicates that the cultivation of students' core literacy, the transformation of teaching methods, and the reconstruction of evaluation systems have become key elements of instructional innovation. Based on these findings, this article proposes specific innovation strategies across three dimensions: updating educational philosophies, optimizing teaching methods, and improving evaluation mechanisms. These strategies include constructing student-centered teaching models, promoting pedagogical practices that integrate inquiry-based and cooperative learning, and establishing a diversified evaluation system. Through systematic instructional innovation, students' core physics literacy can be effectively enhanced, promoting all-round development and providing theoretical guidance and practical reference for high school physics teaching under the NCEE framework.

Keywords: New College Entrance Examination; High School Physics; Teaching Innovation

Introduction

With the continuous advancement of educational reform, the New College Entrance Examination (NCEE) system is being implemented nationwide. This transformation is not merely a change in examination and evaluation methods; it exerts a profound influence on the philosophy and practice of basic education. High school physics, as a fundamental science discipline, plays an irreplaceable role in fostering scientific thinking, innovative capacity, and practical skills. The traditional exam-oriented education model focuses excessively on knowledge transmission and mechanical training, neglecting the cultivation of student subjectivity and creativity. Consequently, this instructional approach is no longer compatible with the requirements of the NCEE reform. The NCEE emphasizes comprehensive quality evaluation and prioritizes the assessment of students' core disciplinary literacy, which presents new challenges and sets higher standards for high school physics teaching. Given this context, exploring how to advance innovation in high school physics teaching under the NCEE background has become an urgent task for educators. This paper aims to systematically analyze the characteristics of the NCEE reform and its impact on physics instruction, exploring innovative pathways that meet the requirements of the times, thereby providing theoretical support and practical guidance for improving the quality of high school physics education.

1. Update of Teaching Philosophy

1.1 Reconstruction of Teaching Objectives Oriented by Core Literacy

Under the background of the New College Entrance Examination (NCEE) reform, high school physics teaching must fundamentally shift its objective orientation from pure knowledge transmission to the comprehensive development of students' core literacy. The core literacy of the physics discipline comprises four dimensions: Physical Concepts, Scientific Thinking, Scientific Inquiry, and Scientific Attitude & Responsibility. These dimensions are interrelated and mutually reinforcing, together forming a complete system of students' physical disciplinary capabilities. Teachers need to deeply understand the connotations of core literacy and organically integrate them into every stage of instructional design. The formation of physical concepts requires students to experience physical phenomena in authentic contexts, establishing a correct conceptual system through observation, experimentation, and reasoning. The cultivation of scientific thinking demands that teachers create problem-driven scenarios, guiding students to analyze physical issues using cognitive methods such as induction-deduction and analogical reasoning. The development of scientific inquiry capabilities relies on students' personal participation in the processes of experimental design, data collection, and conclusion validation. Finally, the establishment of scientific attitude and responsibility should subtly influence students' values through the introduction of the history of physics and discussions on technological ethics.

1.2 Establishment and Strengthening of Student Subjectivity

Modern educational theory emphasizes that the student is the subject of learning activities; teachers should transform from "transmitters of knowledge" into "guides and facilitators of learning." Establishing student subjectivity in high school physics means fully respecting students' cognitive patterns and developmental characteristics to stimulate their intrinsic motivation and curiosity. Teachers need to create a democratic and equal classroom atmosphere, encouraging students to question boldly and explore courageously, while providing ample opportunities for them to express viewpoints and exchange ideas. The manifestation of student subjectivity is also reflected in the autonomy and initiative of the learning process. Teachers should guide students in formulating personalized learning plans, selecting appropriate learning strategies, and monitoring their own progress to adjust methods in a timely manner [1]. Through formats such as Group Cooperative Learning and Project-Based Learning (PBL), students' teamwork spirit and communication skills can be cultivated. In experimental teaching, students must be given more hands-on opportunities to experience the discovery process of physical laws through practice, thereby enhancing their sense of achievement and gain in learning.

1.3 Cultivation of Interdisciplinary Integration Thinking

The NCEE reform advocates for interdisciplinary integration, which requires high school physics teaching to break down disciplinary barriers and strengthen the connection and infiltration between physics and other subjects. As a foundational natural science, physics possesses close internal links with mathematics, chemistry, and biology, while also intersecting with engineering and information technology. In the teaching process, teachers should consciously identify the integration points between physics and other disciplines, utilizing integrated problem design to guide students in applying multi-disciplinary knowledge to solve complex issues. For example, mathematical modeling can be incorporated into mechanics; information technology applications can be integrated into electromagnetism; and principles of chemical reactions can be linked to thermodynamics. This interdisciplinary approach not only deepens students' understanding of physical concepts but also cultivates their ability to synthesize knowledge and fosters innovative thinking qualities. At the institutional level, schools should coordinate curriculum planning to provide the necessary resources and supportive conditions for interdisciplinary instruction.

2. Optimization of Teaching Methods

2.1 Deep Implementation of Inquiry-Based Learning Models

As a problem-oriented pedagogical method, inquiry-based learning can effectively stimulate students' interest and desire to explore, thereby cultivating their scientific thinking and innovative capabilities. Implementing inquiry-based learning in high school physics requires teachers to meticulously design inquiry questions that are sufficiently challenging and open-ended to trigger cognitive conflict and reflection. The design of inquiry activities must adhere to scientific principles, ensuring that experimental conditions are controllable, phenomena are distinct, and results are reliable. During the inquiry process, teachers should provide timely guidance and inspiration to help students overcome difficulties. Crucially, they should not provide direct answers but rather lead students to reach conclusions through their own efforts. The evaluation of inquiry-based learning should focus on the level of student participation, the cognitive process, and innovative performance, rather than solely on the correctness of the final result [2]. To improve the effectiveness of this model, schools must be equipped with comprehensive laboratory facilities and equipment, providing students with sufficient time and space for exploration. Teachers themselves must also continuously improve their professional literacy and master the theoretical foundations and implementation techniques of inquiry-based pedagogy.

2.2 Effective Construction of Collaborative Learning Mechanisms

Collaborative learning is a pedagogical organizational form that achieves common learning goals through interaction and exchange among group members. This approach is instrumental in cultivating students' teamwork spirit and social interpersonal skills. To implement collaborative learning in high school physics, teachers must first form study groups rationally, considering factors such as students' knowledge foundations, ability levels, and individual strengths to ensure complementary advantages within each group. The design of collaborative tasks should possess a certain degree of complexity and integration, making them difficult to complete individually and requiring division of labor and cooperation to reach the goal. During the process, the teacher should act as an organizer, guide, and coordinator, ensuring every student participates actively while preventing individual students from either over-relying on others or dominating the group. The evaluation mechanism for collaborative learning should balance individual performance with collective outcomes, incorporating both group-level assessments and recognition of personal contributions. Through long-term collaborative practice, students not only deepen their understanding of physics but also acquire essential social skills, such as listening to others, expressing unique perspectives, and reconciling differing opinions.

2.3 Deep Integration of Modern Information Technology and Physics Teaching

The rapid advancement of information technology has provided high school physics education with a wealth of tools and platforms, effectively promoting the modernization and diversification of instructional methods. The application of multimedia technology renders abstract physical concepts more intuitive and visualizes complex physical processes vividly, significantly improving teaching effectiveness and learning efficiency. The use of virtual simulation software compensates for the limitations of traditional experimental conditions, allowing students to conduct high-risk or high-cost physics experiments in a safe environment. Furthermore, online learning platforms provide students with personalized resources and a convenient environment, supporting them in managing their own progress and content selection. The application of Artificial Intelligence (AI) is transforming traditional teacher-student relationships and pedagogical models; intelligent tutoring systems can now provide precise learning diagnostics and personalized recommendations [3]. However, the application of information technology is not a simple "stacking" of tools; it must be organically integrated with teaching content and objectives to leverage its unique advantages in promoting comprehension. Teachers must continuously learn new technologies and master new tools to enhance their information literacy while remaining cautious not to over-rely on technology at the expense of teacher-student emotional exchange and humanistic care.

3. Improvement of Evaluation Mechanisms

3.1 Integration of Formative and Summative Assessments

Traditional high school physics teaching evaluations primarily rely on final exam scores. This single assessment method fails to comprehensively reflect students' learning status and developmental levels. In the context of the new college entrance examination, it is necessary to establish a diversified evaluation system that combines formative and summative assessments. Formative assessment focuses on students' performance and developmental changes during the learning process, including classroom participation, quality of homework completion, experimental operation skills, group collaboration performance, and other aspects. This evaluation method can promptly identify problems in students' learning, provide a basis for teachers to adjust teaching strategies, and guide students in improving their learning methods. Summative assessment, on the other hand, emphasizes the examination and evaluation of students' phased learning outcomes, typically conducted through standardized tests. Both evaluation methods have their advantages: formative assessment promotes continuous progress among students, while summative assessment helps objectively measure learning outcomes [4]. By organically combining the two, the comprehensiveness and accuracy of evaluation can be ensured, while also leveraging its motivational and guiding functions. During specific implementation, detailed evaluation standards and operational procedures must be formulated to ensure the scientific rigor and fairness of the evaluation process.

3.2 Construction of a Diversified Evaluation Indicator System

A single performance-based evaluation indicator cannot fully reflect students' physics literacy and comprehensive abilities. It is essential to build a diversified evaluation indicator system encompassing multiple dimensions. The mastery of knowledge remains an important evaluation indicator, but this is only a foundational requirement. More importantly, it is necessary to evaluate students' physics thinking abilities, including logical reasoning, abstract generalization, and modeling skills. Experimental skills and scientific inquiry abilities are also indispensable evaluation components, covering aspects such as experimental design, data processing, and error analysis. The evaluation of innovative awareness and practical abilities reflects attention to students' creative thinking and problem-solving skills. Communication and collaboration skills demonstrate students' performance in team-based learning and social adaptability. The evaluation of attitudes, emotions, and values focuses on students' interest in physics, understanding of the scientific spirit, and awareness of social responsibility. Each evaluation indicator should be independent yet interconnected, forming a complete evaluation framework. The allocation of weights should be reasonably determined based on teaching objectives and students' developmental needs, avoiding the neglect or overemphasis of certain indicators. The formulation of evaluation standards should reflect gradation and differentiation, ensuring the uniformity of basic requirements while allowing for the personalized development of outstanding students.

3.3 Implementation of the Developmental Evaluation Concept

Developmental evaluation emphasizes that the fundamental purpose of assessment is to promote student growth and progress, rather than simple grade classification or ranking. This philosophy requires teachers to view the student’s learning process through a developmental lens, focusing on the magnitude of progress and the level of effort rather than solely on final outcomes. Implementing developmental evaluation in high school physics necessitates the establishment of student growth portfolios to record learning milestones and developmental trajectories. Feedback must be timely and specific, highlighting strengths while providing actionable suggestions for improvement. Furthermore, encouraging self-evaluation and peer-assessment is crucial for cultivating students' self-reflection and self-regulation skills. Evaluation results should primarily serve as an incentive to build confidence and stimulate learning motivation. For students facing learning difficulties, teachers should provide additional support through personalized learning schemes and development plans. This approach also requires teachers to continuously enhance their own evaluative literacy, mastering scientific assessment methods and maintaining keen observational insight [5]. At the institutional level, school management must foster a supportive policy environment and cultural atmosphere to ensure the sustained effectiveness of these evaluation reforms.

Conclusion

The New College Entrance Examination (NCEE) reform presents unprecedented opportunities for high school physics teaching, alongside rigorous challenges. In response to this historic transformation, educators must proactively adapt to the new landscape by transforming teaching philosophies, innovating instructional methodologies, and refining evaluation mechanisms. Realizing high-quality and substantive development in physics education is only possible by remaining student-centered, prioritizing core literacy, and constructing a scientifically sound evaluation system. Future physics instruction will build upon fine traditions while integrating advanced educational concepts and modern technological tools to create a more open, diverse, and efficient teaching environment. This goal requires not only the active exploration of frontline teachers but also policy support from educational authorities and social cooperation. Through collective efforts, high school physics teaching under the NCEE framework will undoubtedly achieve a brighter developmental prospect, contributing significantly to the cultivation of innovative talents for the new era.

References

[1] Jiang, J. C. Analysis of Innovation in High School Physics Teaching Under the New College Entrance Examination Background [J]. Mathematical and Physical World (High School Edition), 2025(8): 63-65.

[2] Guo, L. M. Analysis of High School Physics Teaching Under the New College Entrance Examination Background [J]. Mathematical and Physical World (High School Edition), 2025(6): 69-71.

[3] Gao, J. Research on the Optimization of High School Physics Teaching Under the New College Entrance Examination Background [J]. Mathematical and Physical World (High School Edition), 2025(4): 56-58.

[4] Lv, L. G. Analysis of Strategies for Constructing Efficient Classrooms in High School Physics Experimental Teaching Under the New College Entrance Examination Background [J]. Mathematical and Physical World (High School Edition), 2025(14): 69-71.

[5] Yu, H. P. New Thinking in High School Physics Teaching Under the New College Entrance Examination Background [J]. Mathematical and Physical World (High School Edition), 2025(10): 62-64.