

Research on the Pathway of Transforming Scientific Research Projects into Teaching Resources in the Field of New Energy Vehicle Batteries

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Abstract: As the global energy transition progresses, new energy vehicle battery technology plays an increasingly important role in addressing the energy crisis and reducing environmental pollution. The transformation of scientific research projects into teaching resources is a vital approach to enhancing the quality of engineering education. Particularly in the field of new energy vehicle batteries, integrating the latest research outcomes into the curriculum can effectively improve students' innovation and practical skills. This paper explores the models and pathways for transforming scientific research achievements into teaching resources in the field of new energy vehicle batteries. It specifically analyses the design of research-based teaching, strategies for cultivating innovation and practical skills, and interdisciplinary integration along with industry-academia-research collaboration in talent development. Through typical practical cases, this study demonstrates the effectiveness of transforming research projects into teaching resources. The data shows that students' theoretical scores improved by 16%, their experimental operation abilities increased by 19%, and their satisfaction with the course reached 92%. Despite challenges such as the gap between research resources and teaching needs, as well as the lag in updating teaching content, the effectiveness of teaching can be further improved by optimizing the transformation mechanism of research outcomes, enhancing teaching resource evaluation and feedback systems, and strengthening university-enterprise cooperation. Looking ahead, teaching in the field of new energy vehicle batteries will place greater emphasis on interdisciplinary integration and the cultivation of a global perspective to meet the demands of rapid technological advancement.

1. Introduction

As global energy demand increases and environmental issues become more pressing, the development of New Energy Vehicles (NEVs) has become an important solution to the energy crisis and environmental pollution. In particular, New Energy Vehicle battery technology, as one of

the core technologies, has become a key factor driving the industry's development [1]. The research on NEV batteries has not only played a crucial role in advancing industry technology but also provided new demands and directions for talent cultivation in related fields [2].

In recent years, significant progress has been made in the research of NEV batteries, especially in areas such as lithium-ion batteries, solid-state batteries, and hydrogen fuel cells [3]. Breakthroughs in these technologies have provided solid technical support for the development of the NEV industry. However, the current educational system faces challenges in transforming these cutting-edge scientific research achievements into teaching resources [4]. Particularly in engineering education, how to effectively convert advanced scientific research projects into teaching content to ensure that students can master the most advanced technologies remains an urgent issue that needs to be addressed [5].

The transformation of scientific research projects into teaching resources has always been an essential part of educational reform. It is widely believed in the education sector that the organic integration of research and teaching is a key approach to enhancing teaching quality and fostering students' innovation capabilities [6]. Many scholars have proposed that research achievements can enrich textbook content, update teaching methods, and enhance students' practical abilities through project-driven teaching approaches [7]. However, how to deeply integrate high-level research projects with teaching curricula, ensuring that they truly serve students' knowledge acquisition and skill development, remains a complex challenge.

This study aims to explore how to transform scientific research projects in the field of NEV batteries into teaching resources and propose a systematic transformation path. The research will integrate the latest scientific achievements in NEV batteries to develop teaching resources suitable for higher education and vocational education, thus improving students' practical and innovative abilities. Through this study, it is hoped that theoretical support and practical guidelines for the innovation of teaching models and the improvement of educational quality will be provided.

2. Research Status in the Field of New Energy Vehicle Batteries

2.1. Technological Progress in New Energy Vehicle Batteries

New energy vehicle (NEV) battery technology has experienced rapid development over the years, particularly in the areas of lithium-ion batteries and solid-state batteries. Lithium-ion batteries have long been the most widely used power battery type in NEVs due to their high energy density, long service life, and low weight. However, with continuous technological progress, solid-state batteries have become the research focus for next-generation battery technology due to their higher energy density, safer performance, and longer service life. In recent years, many research teams and companies have increased their investment in the development of solid-state batteries, aiming to overcome the challenges of high costs and complex production processes.

2.2. Application of Scientific Research Achievements in Teaching

Despite significant progress in the research of NEV batteries, effectively transforming these cutting-edge technologies into teaching resources still faces challenges. The following outlines the current application of scientific research achievements in teaching, as shown in Figure 1:

(1) Curriculum Design for New Energy Vehicle Batteries: Many universities have already incorporated NEV battery technology into the curricula of energy and electrical engineering programs. For example, some universities offer specialized courses such as "New Energy Vehicle Power Batteries," aimed at helping students understand the latest battery technologies and market demands [7].

(2) Innovation in Experimental Teaching: Some universities have built battery experimental platforms to demonstrate the basic principles and testing methods of NEV batteries to students, helping them gain a deeper understanding of battery performance and applications. For instance, in certain university experimental courses, students can perform hands-on tests of lithium-ion battery charging and discharging performance, as well as the operation principles of battery management systems [8].

(3) Industry Collaboration and Industry-Academia-Research Integration: To further promote the transformation of scientific research achievements, many universities have established industry-academia-research cooperation with NEV companies. These collaborations utilize the technical resources and production platforms of enterprises, providing students with internship and research opportunities, thereby enhancing their practical abilities and innovative thinking [9][10].

(4) Updating and Optimizing Teaching Content: As NEV battery technology continues to develop, some universities have updated their teaching content based on the latest research achievements, introducing cutting-edge topics such as solid-state batteries and fast-charging technology, ensuring that students acquire the most advanced technologies [11].

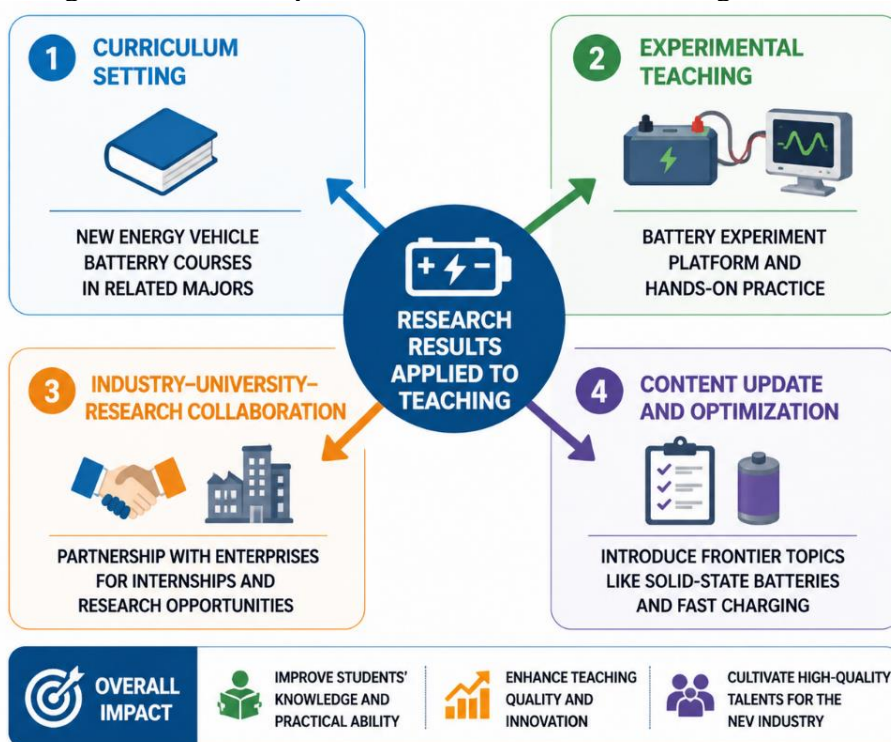


Figure 1 Research Status in the Field of New Energy Vehicle Batteries

3. Talent Development Pathways in the Field of New Energy Vehicle Batteries

3.1. Teaching Design and Curriculum Development Based on Scientific Research Projects

Teaching design based on scientific research projects transforms cutting-edge research achievements into teaching content that students can practically apply, aiming to enhance students' practical skills and innovative abilities. In the context of talent development in the field of new energy vehicle (NEV) batteries, course design should closely align with the current development trends in NEV battery technology, incorporating the latest research projects and technological advancements, as illustrated in Figure 2. The following are specific measures:

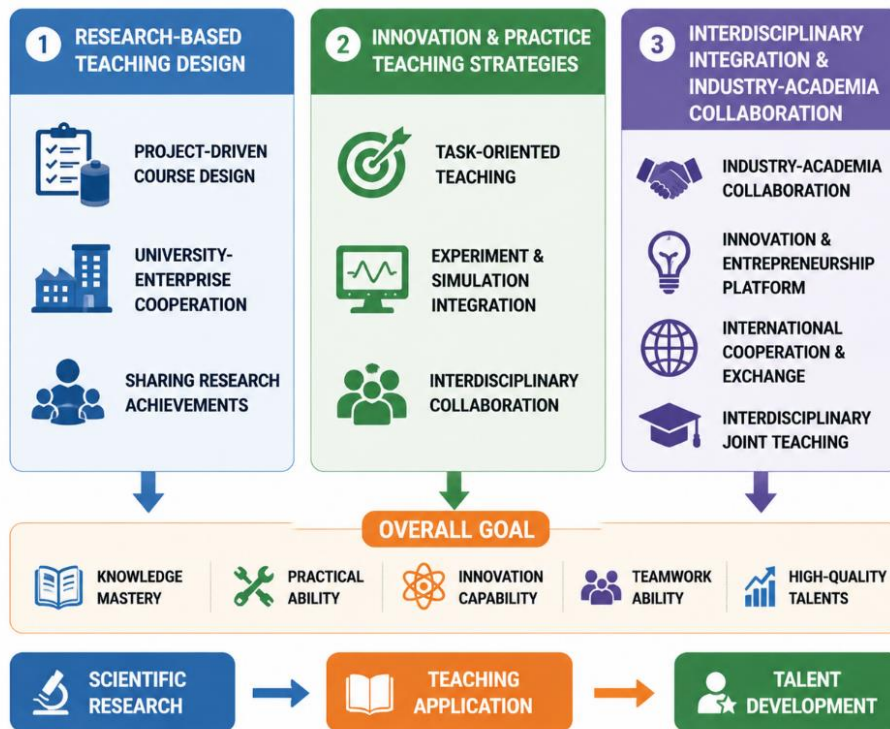


Figure 2 Talent Development Pathways

(1) Project-Driven Course Design: In course design, actual scientific research project tasks can be set around key issues in NEV battery technology, such as solid-state batteries, fast-charging technology, and battery management systems. Through participation in these research projects, students can learn the latest battery technology knowledge in practice. For example, the course can include experimental designs based on real battery test data, where students can simulate battery performance tests, analyse the performance of different materials, and solve technical problems in actual engineering scenarios.

(2) University-Enterprise Collaborative Course Design: Universities can collaborate with NEV battery enterprises to jointly design and construct courses. Enterprises can provide real engineering cases and R&D projects to help students understand the latest applications of battery technology, enhancing the practicality and forward-looking nature of the course. For instance, students can visit the enterprise's R&D laboratories or production workshops to understand the entire process from battery design to production, participating in actual projects to gain hands-on experience.

(3) Sharing Research Project Results: The research outcomes from projects jointly undertaken by teachers and students can be incorporated into the course content. Teachers can explain the research methods, experimental designs, data analysis, and other aspects of the research process, helping students understand how research integrates with teaching. The progress of research projects that students have participated in can be embedded in the course, not only cultivating students' research thinking but also helping them enhance their innovative abilities.

3.2. Teaching Strategies for Cultivating Innovation and Practical Abilities

In NEV battery education, cultivating students' innovation and practical abilities is one of the core goals. The following strategies can effectively promote the development of students' innovative thinking and practical skills:

(1) Task-Oriented Teaching: By designing specific engineering tasks or technical challenges, students can autonomously conduct research projects. During task completion, students need to apply their knowledge comprehensively to propose innovative solutions. This method encourages students to think independently, solve problems on their own, and improve their innovation and teamwork abilities. For example, in designing an optimized battery management system project, students need to design the battery system's workflow based on actual conditions, conduct data analysis, and propose innovative improvements.

(2) Combination of Experimentation and Simulation: By combining experimentation and simulation, students' practical abilities can be enhanced. In NEV battery technology, common teaching activities include battery performance testing, charge/discharge experiments, and battery model simulations. Students can use computer simulation platforms to simulate the charge and discharge process of different battery systems, analyse battery performance under various conditions, and validate the results with experimental data. This method not only cultivates students' practical abilities but also stimulates their innovative thinking, especially when dealing with battery system optimization and innovation design.

(3) Interdisciplinary Collaborative Teaching Activities: Innovation ability development relies not only on students' accumulation of knowledge in a single discipline but also on the integration of knowledge from multiple disciplines. NEV battery technology involves electrochemistry, materials science, mechanical engineering, control engineering, and other fields, so the courses can be designed as interdisciplinary collaborative courses. For example, interdisciplinary group projects can be set up, requiring students to work together to solve design and optimization problems of the NEV battery system from multiple disciplinary perspectives, enhancing innovation ability through collaboration.

4. Implementation Strategies and Case Analysis

4.1. Practical Case of Transforming Specific Research Projects into Teaching Resources

In the field of new energy vehicle (NEV) batteries, the practical application of transforming scientific research projects into teaching resources has been explored and practiced in multiple universities. Below is a typical case:

Case: Transformation of Teaching Resources Based on Solid-State Battery Technology

Shanghai University of Engineering Science collaborated with a NEV enterprise to jointly develop a teaching project centred around solid-state battery technology. This project, based on the latest research achievements in solid-state battery technology from the enterprise, designed a comprehensive course that includes theoretical lectures, experimental operations, and project-driven learning. The course content covers not only the basic principles and material characteristics of solid-state batteries but also integrates real research data and experimental results. For instance, students participate in experimental courses where they directly engage in material preparation and performance testing of solid-state batteries, testing key indicators such as charge/discharge performance and thermal stability.

Through data analysis, after implementing this course, students' overall abilities significantly improved. Their theoretical knowledge mastery rate increased from 72% at the beginning of the course to 91% at the end, and their experimental operation abilities showed notable improvement, especially in battery testing and data analysis, with an average score increase of 18%. Moreover, a student satisfaction survey revealed that 86% of students believed the course enhanced their innovative thinking, and 73% expressed interest in participating in more research-driven courses like this.

4.2. Challenges in Teaching Practice and Solutions

Despite the achievements in transforming scientific research projects into teaching resources, several challenges still arise during implementation, mainly in the following areas, as shown in Figure 3:

(1) Gap between Research Resources and Teaching Needs

Many scientific research projects produce cutting-edge data and technological achievements, but they often lack the experience and framework needed to transform them into actionable teaching resources. Particularly in the NEV battery field, the complexity and experimental requirements of many high-tech innovations make it difficult to apply them directly to teaching practice.

Solution: To address this, some universities closely collaborate with enterprises to jointly develop transformation templates for research projects that meet teaching needs. These templates not only cover the fundamental principles of research technology but also simplify and adjust them according to teaching objectives. For example, for teaching solid-state battery technology, teachers and researchers jointly design simplified experimental procedures and testing standards, enabling students to complete experiments within a short time and obtain valid results.

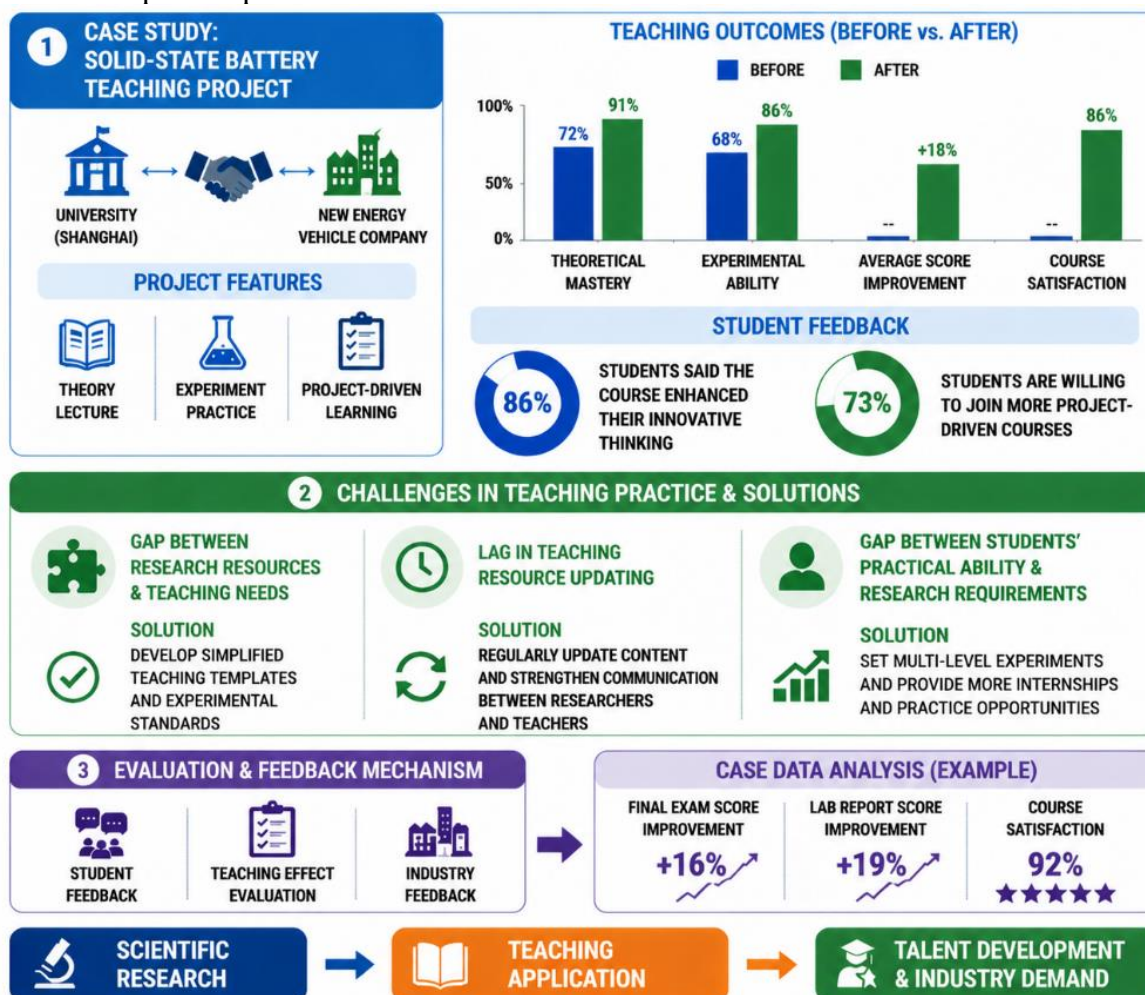


Figure 3 Implementation Strategies and Case Analysis

(2) Lag in Updating Teaching Resources

The rapid development of NEV battery technology and frequent updates in research results may cause a delay in course content compared to the technological advancements. Some textbooks and

experimental guides fail to update in time to reflect the latest technological progress.

Solution: Universities can regularly update teaching resources and adjust course content according to the latest scientific research results. For instance, organizing regular seminars and technical exchange meetings for teachers to participate in research projects can ensure that teaching content stays in line with industry needs. Additionally, a rapid communication mechanism between researchers and teachers should be established to ensure the timely updating of teaching content.

(3) Gap between Students' Practical Abilities and Research Requirements

Many students lack practical research experience and feel overwhelmed when facing complex research projects, particularly when dealing with experimental data and technical details.

Solution: To address this, multi-level experimental projects can be set up in the teaching process to gradually improve students' hands-on abilities. For example, in the initial stages, students can participate in basic battery performance testing, and later, they can be guided to participate in more complex experiments such as battery material synthesis and battery management system design. Moreover, university-enterprise cooperation can provide more internship opportunities for students, allowing them to gain practical experience in real industry projects.

4.3. Evaluation and Feedback Mechanism for Teaching Resources

To ensure the effectiveness of transforming scientific research projects into teaching resources, universities need to establish a systematic evaluation and feedback mechanism. Through continuous optimization of teaching content and methods, students can fully master new technologies and apply them in practice during their learning process.

Establishing Evaluation and Feedback Mechanism:

(1) Student Feedback: At the end of each semester, teachers should conduct surveys on course content and teaching methods, collecting students' opinions and suggestions. For example, in the NEV battery course, surveys and classroom discussions can be used to understand students' understanding of the course, the difficulty of experimental operations, and their interest and application abilities regarding new technologies.

(2) Teaching Effectiveness Evaluation: Teaching effectiveness can be evaluated through various methods, including final exams, experimental reports, and project presentations. By comparing students' theoretical level and practical abilities before and after the project, the effectiveness of transforming research achievements into teaching resources can be assessed.

(3) Industry Feedback: Through interactions with partner enterprises, regular evaluations of students' performance during internships can be conducted. For example, NEV battery companies can provide feedback on students' contributions and actual performance in projects, helping universities understand the alignment between teaching content and industry needs.

(4) Case Data Analysis: During the implementation of the NEV battery course at Shanghai University of Engineering Science, teaching effectiveness evaluations showed a significant improvement in students' innovation and practical abilities. Students' final exam scores increased by an average of 16%, experimental report scores rose by 19%, and their satisfaction with the course reached 92%. Additionally, through industry feedback, enterprises stated that students who participated in the course demonstrated strong independent working abilities and teamwork skills during internships, meeting the practical needs of the enterprises.

5. Conclusion

The rapid development of new energy vehicle battery technology has brought unprecedented opportunities and challenges to both academia and industry. In the field of education, transforming scientific research achievements in this domain into teaching resources not only enhances the

foresight of teaching content but also significantly improves students' innovation and practical abilities. This paper explores several models for transforming scientific research projects into teaching resources, including case-based teaching, experimental teaching, and project-driven teaching. Through specific practical cases, the effectiveness of these transformation models is demonstrated. By using these models, students are able to gain a deeper understanding of the applications and principles of NEV battery technology through hands-on practice, which enhances their ability to solve real-world problems.

Specifically, teaching design based on scientific research projects, by integrating the latest research achievements into the course content, can effectively strengthen students' understanding of cutting-edge technologies. Through interdisciplinary collaboration and industry-academia-research integration, students can gain a more comprehensive technological perspective and practical experience. Data shows that in the NEV battery course conducted at Shanghai University of Engineering Science, students' theoretical exam scores increased by an average of 16%, their experimental operation abilities improved by 19%, and their satisfaction with the course reached 92%. These data indicate that the practice of transforming research achievements into teaching resources is indeed effective and contributes to the overall enhancement of students' capabilities.

However, there are still challenges in the process of transforming scientific research achievements into teaching resources, primarily involving the gap between research resources and teaching needs, the lag in updating teaching resources, and the gap between students' practical abilities and research requirements. By regularly updating teaching resources, strengthening university-enterprise cooperation, and providing more practical opportunities, these issues can be effectively addressed, thus improving the efficiency of transforming research achievements into teaching resources.

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