

# Practical Research on Teaching Reform of Comprehensive Experimental Course Driven by Interdisciplinary Integration and Artificial Intelligence

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**Abstract:** At present, there are many problems in the experimental courses of colleges and universities, such as obvious subject barriers and single teaching methods, which are difficult to adapt to the practical needs of the cultivation of compound talents. This study takes the comprehensive experimental course as the starting point to explore the teaching reform path driven by interdisciplinary integration and artificial intelligence technology. By reconstructing the curriculum system, introducing AI-assisted teaching tools, and optimizing the experimental organization and management mode, a set of operable interdisciplinary comprehensive experimental teaching programs was constructed, and the effectiveness of the reform was systematically evaluated. The practical results show that the model effectively improves the students' comprehensive experimental ability and interdisciplinary thinking level, and has certain reference value for the teaching reform of similar courses.

**Keywords:** interdisciplinary integration, artificial intelligence, teaching reform, compound talents training

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## 1. Introduction

With the deepening of the new round of scientific and technological revolution, the knowledge framework of a single discipline has been difficult to support the analysis and solution of complex engineering problems, and the experimental teaching in colleges and universities needs to break through the limitations of the traditional model. As an important part of connecting theory and practice, the comprehensive experimental course has long faced difficulties such as content fragmentation, insufficient interdisciplinary intersection, and lagging evaluation mechanism. The rapid development of artificial intelligence technology provides new possibilities for solving the above problems. Based on the practice of teaching reform, this study attempts to organically combine the concept of interdisciplinary integration with artificial intelligence technology, and systematically explore from curriculum design, teaching implementation to effect evaluation, in order to provide practical experience for the reform of comprehensive experimental courses<sup>[1]</sup>.

## 2. Core connotation and theoretical framework of interdisciplinary integration and artificial intelligence-driven teaching reform

Interdisciplinary integration is not a simple superposition of multiple courses. Its essence is to break the boundaries of disciplines, reorganize the knowledge system around the real problem situation, and enable students to realize the transfer and integration of knowledge in the process of solving comprehensive tasks. The teaching reform driven by artificial intelligence is to intervene in the whole process of teaching by means of data perception, intelligent

recommendation, adaptive feedback and other technical means, and change the traditional one-way structure of " teacher-led, student passive reception. " The combination of the two constitutes the core logic of the teaching reform in this study : reshaping the curriculum content framework with interdisciplinary integration, improving the accuracy and interactivity of the teaching process with artificial intelligence technology, and jointly serving the cultivation of students ' comprehensive practical ability. This reform idea is compatible with constructivist learning theory and STEM education concept at the theoretical level. It emphasizes the active construction of learners in real situations, and realizes personalized learning support with the help of technical tools, which provides a theoretical basis for the systematic reform of comprehensive experimental courses<sup>[2]</sup>.

### **3. The practice path and mode construction of teaching reform of comprehensive experimental course**

#### **3.1 Interdisciplinary integration of curriculum system design and content integration strategy**

The content reconstruction of the comprehensive experimental course is the basic work of this reform, and it is also the most difficult link. The traditional experimental courses are arranged independently with a single subject as a unit, and there is a lack of organic correlation between the contents. Students generally reflect that ' learning is not useful and can not be found in time '. This fragmented state fundamentally restricts the cultivation of comprehensive practical ability. To this end, this study first systematically sorts out the experimental contents of various disciplines, identifies potential intersections between different disciplines in methodology, tool use, and problem analysis paths, and is driven by real engineering scenarios and comprehensive problems. The decentralized experimental modules are integrated into several interdisciplinary thematic experimental units. Each topic unit covers the core methods and tools of multiple disciplines, requiring students to comprehensively use the knowledge resources of different disciplines in the process of completing experimental tasks, rather than mechanically operating within a single framework.

At the content level, the curriculum adopts a progressive structure of ' basic layer-comprehensive layer-innovation layer ' : the basic layer focuses on the consolidation of the core skills of a single subject, the comprehensive layer guides students to solve the problem of medium complexity through interdisciplinary integration, and the innovation layer takes open topics as the carrier to encourage students to independently design experimental programs and promote them independently. In addition, in terms of content selection, we should pay attention to the integration with the forefront of the industry, and appropriately incorporate the new methods and tools that have emerged in the interdisciplinary fields in recent years into the curriculum, so as to avoid the disconnection between teaching content and practical application. On the whole, the reconstructed curriculum system has achieved a relatively reasonable balance between the breadth and depth of knowledge coverage, and provides a solid support for interdisciplinary integration from the content level.

#### **3.2 Application mode and tool support of artificial intelligence technology in comprehensive experimental teaching**

The introduction of artificial intelligence technology is an important feature of this reform, which is different from the previous teaching exploration. Its application logic is not to replace teachers with technology, but to make up for the shortcomings of traditional teaching in personalized support and process monitoring through data perception and intelligent processing. Specifically, the application of technology is mainly reflected in four aspects : First, data collection and behavior analysis of the experimental process. With the help of sensor equipment, operation log recording system and intelligent platform, students ' operation steps, time allocation and error types in the experimental process are collected in real time to form structured learning behavior data, which provides objective basis for subsequent learning situation diagnosis and changes the evaluation method that teachers mainly rely on subjective observation in the past. Second, personalized resource recommendation based on learning portraits. According to the experimental progress, previous performance and weak links of each student, the system dynamically pushes targeted reference materials, operation videos and supplementary exercises, realizes the implementation of teaching students in accordance with their aptitude at the technical level, and fundamentally changes the " one size fits all " counseling mode.

Third, the embedding of intelligent feedback mechanism. At the key experimental nodes, the system automatically identifies the typical errors in the student's operation and gives immediate prompts, without waiting for the teacher's guidance one by one, which significantly improves the efficiency of classroom error correction and also helps to cultivate students' self-reflection habits. Fourth, the collaborative application of virtual simulation platform. Students can carry out simulation training through AI-driven virtual experimental environment before real operation, familiarize themselves with the experimental process, predict potential risks, effectively reduce equipment loss and safety hazards caused by operation errors, and provide flexible supplementary means for teaching under limited operating conditions. The application mode of the above four levels cooperates with each other, which greatly improves the accuracy of the teaching process and the depth of students' active participation without significantly increasing the workload of teachers.

### **3.3 Teaching implementation plan and organization management based on interdisciplinary integration and artificial intelligence-driven**

At the level of teaching implementation, this study designed a four-stage classroom process of 'problem introduction-collaborative inquiry-technical assistance-results reporting'. Before class, teachers release interdisciplinary problem situations through intelligent platforms to guide students to acquire relevant subject knowledge in advance; in the course, students carry out collaborative experiments in heterogeneous groups, and AI tools monitor progress in real time and provide data support; after class, the system automatically generates experimental report analysis and personal ability report for teachers to adjust the teaching focus of the next stage. In terms of organization and management, it has broken the original single teacher package mode, promoted the interdisciplinary teacher collaborative teaching mechanism, clarified the division of responsibilities of teachers in various disciplines, and established a regular collective lesson preparation system to ensure that the interdisciplinary integration of curriculum content is implemented rather than a mere formality.

## **4. Teaching reform effectiveness evaluation and continuous optimization mechanism**

### **4.1 Effect evaluation system and empirical analysis of comprehensive experimental teaching reform**

This study constructs a comprehensive evaluation system covering four dimensions: knowledge integration ability, experimental operation level, interdisciplinary thinking and team cooperation performance. It uses a combination of process evaluation and summative evaluation, supplemented by questionnaire survey and interview data, to investigate the reform effect from multiple perspectives. Taking the two-year students participating in the reform pilot as a sample, compared with the historical data before the reform, it is found that the students' scoring rate on interdisciplinary knowledge application topics has increased by about 18%, the logic and integrity of the experimental report have been significantly improved, and more than 80% of the students said in the interview that the actual relevance of the course content has been significantly enhanced [3]. The intervention of artificial intelligence tools also objectively improves the standardization of experimental data and the traceability of error rate. Teachers' mastery of students' learning situation is more timely and accurate, and the basis of teaching decision-making is more sufficient.

### **4.2 Reflections on the problems of teaching reform, experience summary and suggestions for popularization and application**

In the process of reform, some practical problems have also been exposed: the time cost of interdisciplinary teachers' collaborative lesson preparation is relatively high, some teachers are not yet proficient in the operation of AI tools, and there is a certain administrative resistance in the coordination of the allocation of class hours in various disciplines, which leads to the slow pace of reform in the early stage of reform. In this regard, this study believes that the implementation of interdisciplinary teaching reform requires supporting institutional guarantees, including clear incentive policies, sustainable training mechanisms, and flexible curriculum arrangement systems. It is difficult to maintain long-term operation only by the enthusiasm of individual teachers. In terms of promotion suggestions, it is suggested that other colleges and universities should combine their own discipline structure characteristics, select 2 to 3

disciplines with strong correlation to carry out pilot projects, gradually accumulate experience and then expand the coverage, avoid being greedy for perfection, and avoid the reform from losing its substantive effect.

## **5. Conclusion**

Focusing on the teaching reform of comprehensive experimental course, this study systematically explores the practical path of interdisciplinary integration and collaborative application of artificial intelligence technology. From the reconstruction of the curriculum system to the introduction of teaching tools, and then to the optimization of the evaluation mechanism, each link supports each other, forming a relatively complete reform closed loop. Practice shows that this model has achieved remarkable results in improving students' interdisciplinary comprehensive ability, but its sustainable promotion still depends on the supporting support at the institutional level. The follow-up research can further focus on the boundary problem of the deep integration of artificial intelligence technology and teaching, as well as the standardization of interdisciplinary evaluation standards, so as to provide more universal theoretical support and practical reference for a wider range of teaching reform.

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