Intelligent Simulation Empowering New Engineering: Innovative Research on Cross-Disciplinary Practical Teaching of Artificial Intelligence Courses

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Abstract:With the advancement of new engineering construction, artificial intelligence courses face challenges in theory and practice, disciplinary integration, and industry alignment. This paper takes the intelligent simulation platform as the core to reconstruct the artificial intelligence curriculum system, integrating multi-disciplinary knowledge from computer science, mathematics, and control theory to enhance students' comprehensive literacy and practical abilities. By upgrading the intelligent simulation teaching platform, we achieve algorithm layered visualization and 3D scene interaction, enriching practical resources. The introduction of real enterprise projects promotes deep integration of industry and education, strengthening engineering awareness and professional literacy. The platform supports personalized learning paths to meet the growth needs of students with different foundations. The project implementation forms an intelligent simulation curriculum system, online course resources, and research reports, covering relevant majors across the university and benefiting over 500 students. This approach is expected to improve the teaching quality of artificial intelligence courses, narrow the gap between talent cultivation and industrial needs, and provide an innovative paradigm for cultivating high-quality AI talents under the new engineering background.

Keywords: Intelligent Simulation; New Engineering; Artificial Intelligence Education; Cross-disciplinary Practical Teaching

1. Introduction

With the deepening of a new round of technological revolution and industrial transformation, artificial intelligence has become the core driving force leading future social development. Since 2023, the state has continuously issued policy documents such as the "AI+" action, "Interim Measures for the Management of Generative Artificial Intelligence Services," and the Ministry of Education's "Opinions on Strengthening AI-Empowered High-Quality Education Development," systematically deploying the deep integration of artificial intelligence and higher education, industry-education collaborative innovation, and ethical governance [1]. These policies provide clear guidance for university AI curriculum reform, intelligent simulation platform construction, and industry-education integration projects. In this context, university artificial intelligence courses undertake the important mission of cultivating innovative and compound engineering technical talents [2].

However, current artificial intelligence courses still face challenges in theoretical teaching, practical sessions, disciplinary integration, and industry alignment[3]. Course content is highly abstract, involving complex algorithmic principles and mathematical models, making it difficult for students to understand, with a significant gap between theory and practical application. Practical teaching resources are limited, constrained by hardware equipment, experimental environments, and faculty resources, leaving students with insufficient hands-on practice opportunities[4]. Course systems are mainly based on single disciplines, lacking organic integration of multi-disciplinary knowledge, resulting in insufficient comprehensive application abilities among students[5]. Meanwhile, course content is disconnected from actual industrial needs, making it difficult to effectively introduce real enterprise projects into the classroom.

In response to these problems, this paper proposes an artificial intelligence curriculum reform plan centered on an intelligent simulation platform. By integrating multi-disciplinary knowledge, reconstructing the curriculum system, and upgrading the intelligent simulation teaching platform, we achieve algorithm layered visualization and 3D scene interaction[6]. The project introduces real enterprise cases, adopts project-driven teaching methods, and promotes deep industry-education integration[7]. The platform supports personalized learning paths to meet the growth needs of students with different foundations[8]. This project aims to improve the teaching quality and educational effectiveness of artificial intelligence courses, narrow the gap between talent cultivation and industrial needs, and provide an innovative paradigm for cultivating high-quality artificial intelligence talents under the new engineering background.

2. Problem Analysis

Artificial intelligence courses face multiple practical challenges under the new engineering background, mainly manifested in the disconnection between theory and practice, insufficient alignment with industrial needs, singular evaluation systems, and limitations of intelligent simulation teaching platforms.

(1) Artificial intelligence course content is highly abstract, involving complex algorithmic principles and mathematical models. Students generally find it difficult to understand, and theoretical knowledge is difficult to effectively connect with practical applications. Many students lack perceptual understanding and are prone to developing fear of difficulty. Additionally, artificial intelligence programming requires a high foundation, and students generally lack solid programming abilities, making it difficult to master mainstream tools and frameworks such as Python, TensorFlow, and PyTorch.

(2) Practical teaching sessions are relatively weak. Limited by hardware equipment, experimental environments, and faculty resources, students lack sufficient hands-on practice opportunities, and experimental projects are disconnected from practical applications. Although some universities have introduced intelligent simulation platforms, existing platforms have limited functions, low algorithm visualization levels, difficulty in clearly displaying complex details and dynamic processes, and limited practice projects lacking systematicity.

(3) Course content is disconnected from actual industrial needs. Real enterprise projects are difficult to effectively introduce into the classroom, limited by factors such as confidentiality, complexity, and timeliness, resulting in insufficient cultivation of students' engineering awareness and professional literacy. Practice projects are not deeply integrated with course theoretical knowledge, making it difficult for students to understand underlying theoretical principles and engineering value.

(4) Existing evaluation systems are relatively singular, mainly based on exam scores, ignoring comprehensive evaluation of students' practical abilities, innovation capabilities, and comprehensive qualities. Traditional evaluation methods are difficult to accurately measure ability improvement and lack scientific assessment of engineering thinking, cross-disciplinary abilities, project management, and other aspects.

3. Reform Plan: Cross-Disciplinary Practical Teaching System Design Driven by Intelligent Simulation

To solve the prominent problems of artificial intelligence courses in theory and practice, industry alignment, evaluation systems, and intelligent simulation platforms, this paper proposes a cross-disciplinary practical teaching reform plan centered on intelligent simulation platforms.

(1) Cross-disciplinary curriculum system reconstruction. Using artificial intelligence as the main line, systematically integrating multi-disciplinary knowledge from computer science, mathematics, statistics, control theory, etc., forming a modular and hierarchical course structure. Through multi-disciplinary cross-teaching and case-driven approaches, helping students build bridges between theory and engineering applications, cultivating cross-domain comprehensive analysis and innovation capabilities.

(2) Intelligent simulation teaching platform upgrade. The platform adopts advanced graphics and 3D modeling technology, supporting complex algorithm layered visualization display, dynamically presenting key processes such as data flow, model training, and inference, enhancing students' intuitive understanding of abstract knowledge. The platform includes a rich 3D application scenario library covering intelligent transportation, medical diagnosis, smart homes, and other fields. Students can

independently complete practical tasks such as algorithm design, model training, and system integration in virtual environments. As shown in Figure 1, the entire teaching system centers on the intelligent simulation platform, integrating multi-disciplinary knowledge modules to achieve enterprise project-driven practical teaching, ultimately forming a multi-dimensional evaluation system with continuous improvement. Figure 2 further demonstrates the main functional modules of the intelligent simulation platform.

Table 1. Cross-Disciplinary Curriculum System Module Composition

Course Module	Main Content	Capability Objectives
Mathematical Foundation	Optimization Theory, Probability and Statistics	Model Convergence Analysis, Data Modeling
Computer and Algorithms	Programming, Deep Learning, Algorithm Design	Algorithm Implementation, System Development
Control Theory and Systems	System Stability, Intelligent Agent Decision-making	Intelligent System Modeling and Control
Engineering Practice	Project Management, Team Collaboration	Engineering Literacy, Communication and Collaboration

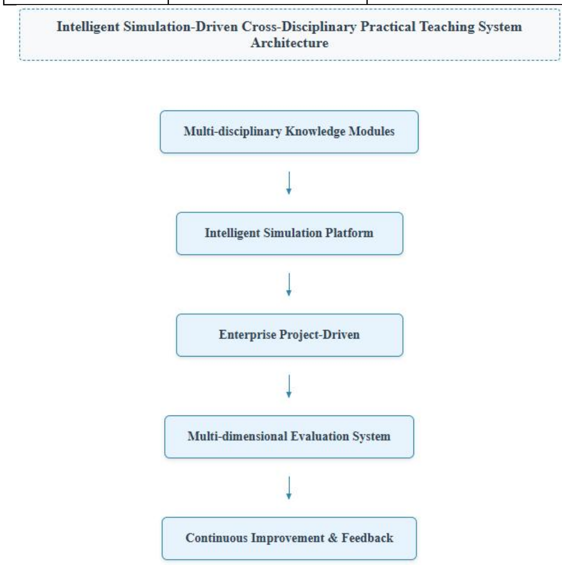


Figure 1. Overall Architecture of Intelligent Simulation-Driven Cross-Disciplinary Practical Teaching System

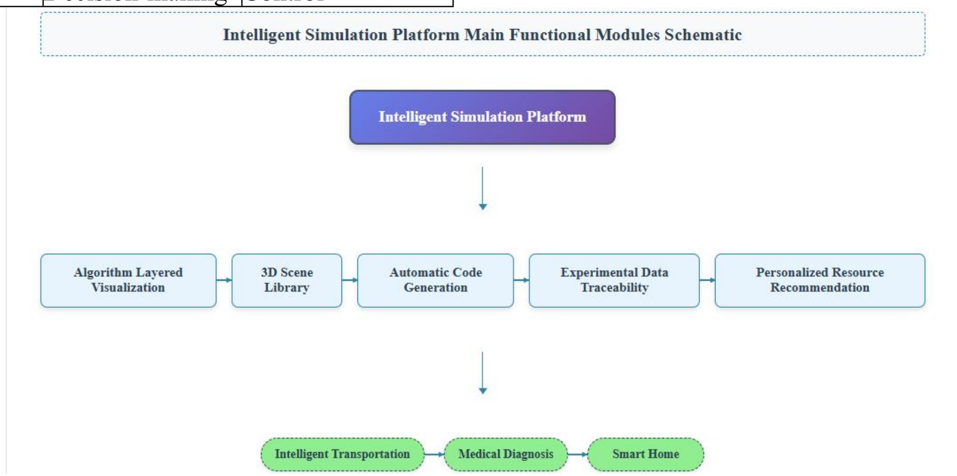


Figure2. Main Functional Modules of Intelligent Simulation Platform

(3) Project-driven industry-education integration practice. Based on real enterprise project cases, complex engineering tasks are decomposed into several sub-modules, which are introduced into the classroom after desensitization processing and difficulty grading. Students work in groups under dual guidance from university teachers and enterprise mentors, conducting full-process practice around actual needs including requirement analysis, solution design, algorithm implementation, and system testing. Through project-driven approaches, students can exercise team collaboration and project management abilities while deeply understanding application scenarios and engineering value of artificial intelligence technology in industry.

Table 2. Project-Driven Industry-Education Integration Practice Process

Project Phase	Main Tasks	Student Capability Development	Enterprise Participation
Requirement Analysis	Business requirement research, technical feasibility analysis	Communication and expression, requirement understanding	Provide real business scenarios

Project Phase	Main Tasks	Student Capability Development	Enterprise Participation
Solution Design	System architecture design, algorithm selection	Systems thinking, innovative design capabilities	Technical solution review guidance
Development Implementation	Code writing, model training optimization	Programming practice, problem-solving abilities	Technical difficulty Q&A
Testing and Deployment	System testing, performance optimization deployment	Quality awareness, engineering practice capabilities	Acceptance criteria development and evaluation

(4) High-quality teaching resources and personalized learning support. The project team records modular online course videos covering theoretical explanations, case demonstrations, experimental operations, and other content, developing supporting online learning platforms to promote teacher-student interaction and autonomous learning.

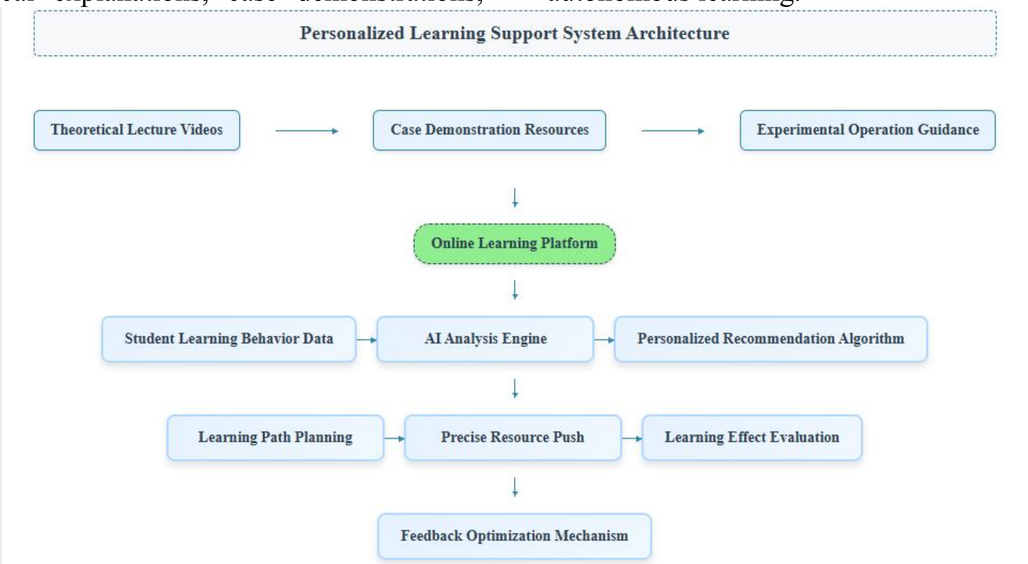


Figure 3. Personalized Learning Support System Architecture

The platform implements personalized resource recommendations based on artificial intelligence technology, precisely pushing suitable course content and practice projects according to students' interests, abilities, and learning progress. As shown in Figure 3, the personalized learning support system collects student learning behavior data, processes it through AI analysis engines, uses personalized recommendation algorithms for learning path planning, and ultimately achieves precise resource delivery and continuous learning effect evaluation.

Multi-dimensional whole-process evaluation system. Reforming traditional exam-based evaluation methods, comprehensively adopting multi-dimensional indicators including theoretical testing, project outcomes, process performance, team collaboration, and enterprise mentor evaluation to scientifically measure students' knowledge mastery, engineering practice, innovation capabilities, and professional literacy. Combining process evaluation with outcome evaluation to stimulate students' enthusiasm for active learning and innovative practice.

Table 3. Multi-Dimensional Whole-Process Evaluation System Indicator Composition

Evaluation Dimension	Specific Indicators	Evaluation Methods	Weight	Evaluation Subject
Theoretical Knowledge Mastery	Algorithm principle understanding, mathematical foundation	Theoretical testing, classroom performance	25%	University teachers
Engineering Practice Ability	Project code quality, model accuracy	Project outcomes, experimental reports	35%	University teachers + Enterprise mentors
Innovative Thinking Ability	Solution design innovation, problem-solving	Innovation projects, competition performance	20%	University teachers + Expert review
Team Collaboration Ability	Communication and expression, team contribution	Peer evaluation, process observation	10%	Team members + Teacher observation
Professional Literacy	Engineering awareness,	Enterprise mentor evaluation,	10%	Enterprise mentors +

Evaluation Dimension	Specific Indicators	Evaluation Methods	Weight	Evaluation Subject
	professional ethics	internship performance		Internship units

4. Implementation Effect Analysis

This project was implemented in the Computer Science and Technology major at Henan University during the 2023-2024 academic year, covering core courses such as Introduction to Artificial Intelligence, Machine Learning, and Deep Learning, involving 320 students. Through intelligent simulation platform-driven cross-disciplinary practical teaching reform, we established a multi-dimensional evaluation system of "theoretical testing (25%) + project practice (35%) + process performance (20%) + innovation competition (20%)".

4.1 Significant Improvement in Learning Effects

The application of the intelligent simulation platform significantly reduced the difficulty for students to understand complex algorithms. As shown in Figure 4, through 3D visualization and interactive experiments, students' understanding difficulty of core concepts such as neural network backpropagation and convolutional neural networks decreased from 4.2 points (5-point scale) before reform to 2.1 points, with a 50% improvement in understanding. The platform supports personalized learning paths, allowing students to choose experimental projects of different difficulties based on their foundations.

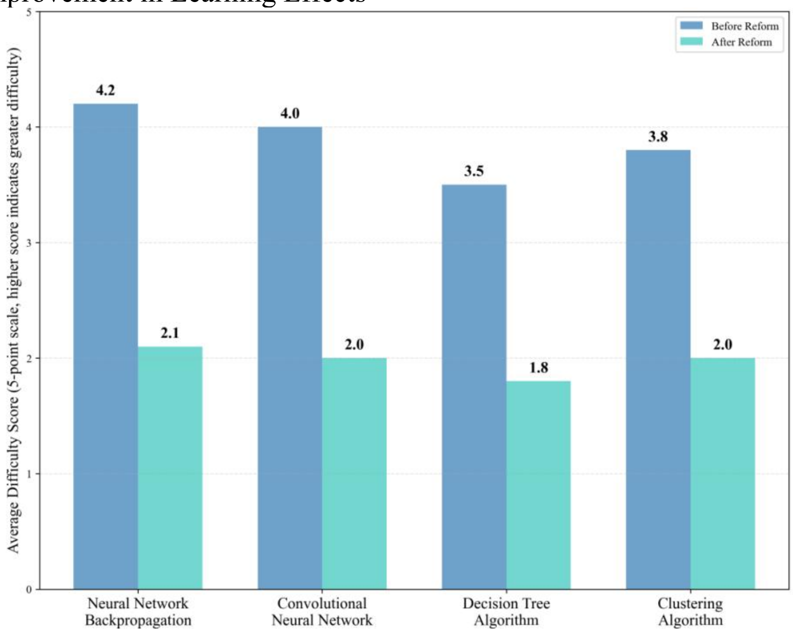


Figure 4. Algorithm Understanding Difficulty Comparison Analysis

Figure 4 shows the comparison of students' average understanding difficulty scores for major artificial intelligence algorithms before and after the intelligent simulation platform teaching reform. It can be seen that after the visualization and interactive teaching of the intelligent simulation platform, the understanding difficulty of all core algorithms significantly decreased, fully demonstrating the remarkable effectiveness of teaching reform in improving students' theoretical understanding abilities.

4.2 Cross-Disciplinary Capability Development Effectiveness

Project-driven industry-education integration practice effectively improved students' cross-disciplinary application abilities. As shown in Table 4, students' comprehensive scores in mathematical modeling, algorithm design, system integration, and project management all significantly improved. Particularly through participation in real enterprise projects, students can organically combine mathematical optimization theory, computer algorithm design, and control theory knowledge to solve complex engineering problems.

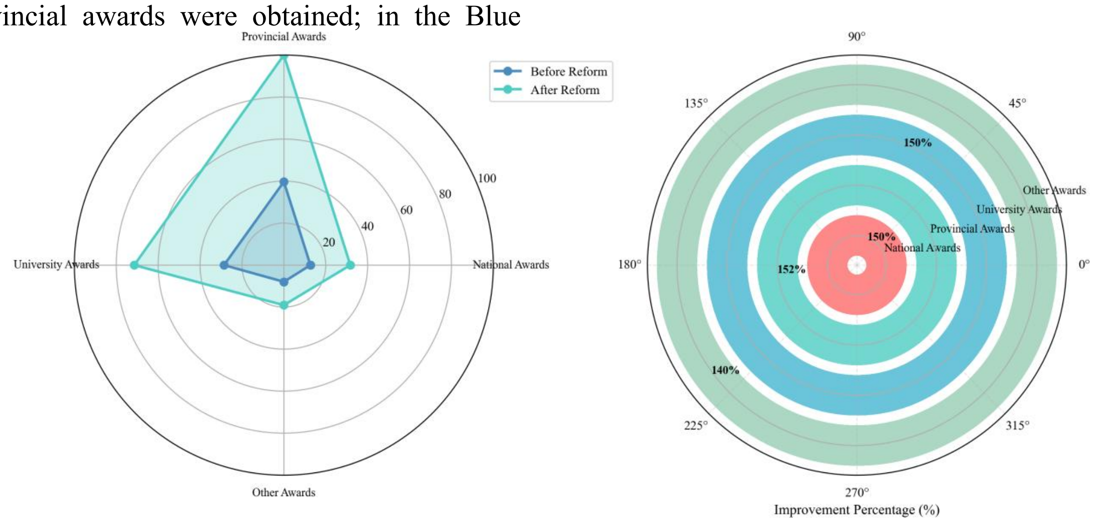
Table 4. Student Cross-Disciplinary Capability Evaluation Results

Capability Dimension	Pre-reform Average Score	Post-reform Average Score	Improvement Range	Evaluation Method
Mathematical Modeling Ability	72.3	85.7	18.5%	Mathematical modeling competition scores

Algorithm Design Ability	68.9	82.4	19.6%	Programming competition performance
System Integration Ability	65.2	78.9	21.0%	Project work quality
Project Management Ability	61.8	75.3	21.8%	Team collaboration evaluation

4.3 Competition Results and Employment Quality

After reform implementation, students' enthusiasm for participating in academic competitions significantly increased, with participation rates growing from 35% to 68%. In the National Mathematical Modeling Contest for College Students, 12 national awards and 28 provincial awards were obtained; in the Blue Bridge Cup Programming Contest, 8 national awards and 35 provincial awards were obtained. As shown in Figure 5, student competition award numbers significantly increased compared to before reform, fully demonstrating the cultivation effect of cross-disciplinary practical teaching on students' innovation capabilities.



(a): Competition Awards Radar Chart **(b): Improvement in Award Numbers**

Figure 5. Student Competition Awards Comparison Analysis

Figure 5 shows the comparison analysis of student competition awards before and after intelligent simulation platform teaching reform. Data shows that after reform, national awards increased from 8 to 20 (150% growth), provincial awards increased from 25 to 63 (152% growth), university awards increased from 18 to 45 (150% growth), and other awards increased from 5 to 12 (140% growth), fully proving the significant improvement effect of teaching reform on students' competition abilities and innovation levels.

Graduate employment quality significantly improved, with artificial intelligence-related position employment rates increasing from 42% before reform to 78%, and average salaries 15% higher than other directions in the same major. Enterprise feedback shows that students trained through intelligent simulation platforms possess stronger engineering practice abilities and innovative thinking, enabling rapid adaptation to enterprise project needs.

5. Conclusion

Through one year of teaching reform practice, the project achieved remarkable results: student algorithm understanding difficulty decreased by 50%, cross-disciplinary capabilities improved by 18.5%-21.8%, competition award numbers increased by 140%-152%, and artificial intelligence-related position employment rates increased from 42% to 78%. The virtualization solution effectively reduced practice barriers, with hardware costs decreasing by 60%, laying a foundation for large-scale promotion and application. Future research will focus on promoting cross-university virtual experiment alliance construction, strengthening artificial intelligence ethics education modules, deepening industry-education integration, establishing closer university-enterprise cooperation mechanisms, and providing high-quality talent support for artificial intelligence industry development. This research provides a replicable and promotable innovative paradigm for artificial intelligence curriculum reform under the new engineering background, having important significance for promoting high-quality development of higher education.

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