AI-Empowered Interdisciplinary Teaching of AI Fundamentals

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Abstract: Artificial intelligence is profoundly reshaping the landscape of higher education talent cultivation. However, current university-level Fundamentals of Artificial Intelligence courses commonly suffer from content confined to technical principles, instruction detached from real-world application scenarios, and monolithic assessment methods, making it difficult to effectively cultivate students' interdisciplinary innovation literacy. Drawing on constructivist learning theory and the frontiers of generative AI in education, and grounded in the curriculum reform practice at Alibaba Business School, Hangzhou Normal University, this paper proposes and constructs a new paradigm of "AI-empowered interdisciplinary integrated teaching". Centered on the core idea of "teaching AI with AI", the paradigm features a flexible "core module + cross-disciplinary application module" curriculum structure, systematically implements AI-enhanced interdisciplinary project-based learning, and establishes a multi-dimensional dynamic assessment system focused on "interdisciplinary innovation literacy". Through a closed-loop pathway of "theoretical construction – curriculum redesign – teaching practice – assessment reform – iterative dissemination", this paper details the practical outcomes, evaluation methods, and data analysis results, and draws conclusions and future research directions. It aims to provide an actionable and replicable solution for AI general education reform in higher education.

Keywords: Fundamentals of Artificial Intelligence; Interdisciplinary Integration; AI-Empowered Teaching; Project-based Learning; Teaching Paradigm; Curriculum Reform Practice

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1 Introduction

With the explosive development of generative artificial intelligence (Generative AI), large language models represented by ChatGPT and DeepSeek are profoundly transforming the ways knowledge is produced and disseminated. According to Stanford University's AI Index Report 2025, AI has approached or even surpassed the average human level in tasks such as complex reasoning and mathematical problem solving. This technological inflection point imposes an urgent demand on higher education: not only should students "understand AI", but they must also "use AI adeptly and skillfully", being able to leverage AI as a core tool for interdisciplinary innovation [1, 2].

Nevertheless, three prominent problems exist in the current teaching practice of university Fundamentals of Artificial Intelligence courses. First, the content system overemphasizes technical principles and algorithmic details, lacking organic integration with authentic interdisciplinary scenarios; consequently, students find it difficult to transfer AI knowledge to their own disciplinary fields after the course [3]. Second, the instructional model remains lecture-dominated, and project-based learning tends to be perfunctory, failing to deeply integrate generative AI tools as intelligent collaborators [4]. Third, assessment methods rely mainly on final examinations and code assignments, neglecting higher-order abilities such as

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problem decomposition, technology selection, and collaborative innovation. These problems trap the course in a dilemma of "teaching technology without using technology, and talking about integration without practicing integration" [5].

To address the above dilemma, this paper proposes and puts into practice a new paradigm of "AI-empowered interdisciplinary integrated teaching". Its core is "using AI technology to drive AI teaching reform" – not only treating AI as teaching content but also as the central engine to restructure teaching processes, create learning contexts, and empower student innovation. Grounded in the curriculum reform practice at Alibaba Business School, Hangzhou Normal University, this study aims to develop a theoretically clear, operationally feasible, and scientifically assessed teaching paradigm, providing a reference for similar course reforms.

2 Literature Review

2.1 Interdisciplinary Education: Theory and Practice

Interdisciplinary education emphasizes breaking traditional disciplinary boundaries and solving complex problems by integrating multiple disciplinary perspectives. Klein [6], and Clark and Wallace [7] point out that genuine interdisciplinary learning is not a simple juxtaposition of multi-disciplinary content but a deep integration of concepts, methods, and cognitive frameworks. In engineering education, the CDIO (Conceive-Design-Implement-Operate) framework has been widely adopted to cultivate systematic thinking and innovation capability. In recent years, the construction of "New Engineering" and "New Liberal Arts" has further promoted interdisciplinary curriculum reform, highlighting the multi-directional empowerment of technology with the humanities and social sciences. Yu and Niu [8] systematically analyzed the connotations, dilemmas, and pathways of interdisciplinary curriculum development in higher education in the new era, pointing out that current interdisciplinary courses generally suffer from "formal integration but substantive separation", calling for systemic restructuring in curriculum structure, teaching methods, and assessment mechanisms.

2.2 Research Progress in AI Educational Applications

The application of AI in education has undergone a paradigm shift from "tool-assisted" to "intelligent collaboration". Early research focused on intelligent tutoring systems (ITS) and adaptive learning platforms. In recent years, the rise of generative AI has brought revolutionary opportunities to education. Mollick and Mollick [9] proposed integrating large language models into teaching in three roles: "AI tutor", "AI collaborator", and "AI simulator". Zhao et al. [10] systematically reviewed the application of large language model-based recommendation systems in personalized learning path generation. Garcia et al. [11] explored the development and application of intelligent educational tools, emphasizing that deep integration of tools with instructional contexts is key to enhancing effectiveness. Luckin and Holmes [12] systematically argued for the potential of AI in education, proposing the core framework of "AI as a learning companion". Zawacki-Richter et al. [13], in a systematic review of AI applications in higher education, found that the vast majority of studies focus on technical development, lacking in-depth exploration of pedagogical change and the role of teachers.

Zárate-Torres et al. [14] systematically analyzed the application models and risk prevention of generative AI in teaching, proposing a three-stage integration pathway of "AI assistance – human-AI collaboration – AI leadership". Huang et al. [5] critically reflected on the value of AI in education, noting the risk of "technology supremacy and educational void" in current practices, and called for a return to a student-development-centered value logic. However, existing research mostly focuses on introducing AI tools into a single course, lacking a systematic paradigm for "AI-empowered interdisciplinary integrated teaching".

2.3 Project Based Learning and Teacher Competence Frameworks

Project-based learning (PBL) is an important vehicle for cultivating interdisciplinary abilities. Williamson [15], and Al-Qoyyim and Kurniawan [16] summarized five core features of PBL: authentic tasks, student autonomy, inquiry-driven processes, outcome orientation, and iterative reflection. In AI education, PBL has been further extended to "AI-enhanced PBL", which uses AI to generate cases, assist solution design, and provide immediate feedback. Regarding assessment, traditional summative assessment struggles to measure innovation literacy; multi-method approaches such as process assessment, rubric assessment, and e-portfolios are becoming mainstream [17]. Łodzikowski et al. [2] particularly pointed out that when designing learning tasks with generative AI, teachers need to reposition their roles from knowledge transmitters to learning task designers and AI collaboration guides.

Teacher competence is key to successful reform. Koehler and Mishra [18] proposed the TPACK framework (Technological Pedagogical Content Knowledge), which provides a classic theory for understanding teacher professional development in the AI era. Mittal et al. [1] further proposed a "digital intelligence-empowered new educational ecosystem", emphasizing that teachers need to develop the ability to collaborate with AI agents. The Ministry of Education of the People's Republic of China (2018), in its Opinions on Accelerating the Construction of High-level Undergraduate Education and Comprehensively Improving Talent Cultivation Capacity, explicitly called for promoting classroom teaching revolution and enhancing teachers' information technology teaching capabilities. These studies provide theoretical foundations for the teacher support strategies and teaching community building in this paper.

3 Research Design and Paradigm Construction

3.1 Core Idea: Teaching AI with AI, Integrating for Integration

This paradigm proposes the meta-cognitive idea of "teaching AI with AI", elevating AI from teaching content to a teaching driver. This is embodied in a dual empowerment: first, AI empowers the teaching process – using generative AI to assist teachers in case generation, learning analytics, and personalized tutoring; second, AI empowers students' innovation ability – cultivating students to use AI as an "intelligent collaborator" for interdisciplinary problems, rather than merely as a coding tool.

3.2 Curriculum Restructuring: The "Core + Cross-disciplinary Application" Dual-Module Structure

Breaking with the traditional catalog organized by technical schools, we construct a flexible and integrated curriculum structure. The core module concisely covers core concepts and principles of machine learning, neural networks, natural language processing, etc., emphasizing conceptual understanding over mathematical derivation. The cross-disciplinary application module dynamically introduces "AI+X" themes aligned with the university's strengths, such as "AI + Digital Humanities", "AI + Smart Finance", and "AI + Bioinformatics". Each theme comprises four parts: domain problem introduction, data characteristic analysis, analysis of typical AI solutions, and ethical discussion.

3.3 Teaching Model Innovation: AI-Enhanced Interdisciplinary Project-Based Learning

We systematically design and implement an "AI-enhanced PBL" process. Project tasks originate from real-world interdisciplinary scenarios (e.g., "public sentiment evolution analysis based on social media data", "design of an auxiliary diagnosis algorithm for microscopic images"). Generative AI tools are deeply integrated throughout the entire process: at the project initiation stage, AI assists in generating literature review drafts and problem decomposition; at the solution design stage, AI acts as an "untiring collaborative partner" for brainstorming and solution iteration; at the technical implementation stage, AI supports code debugging and algorithm selection; at the outcome defense stage, AI simulates the questioning of different disciplinary experts. Throughout, students are required to critically evaluate AI outputs and transform them originally.

3.4 Assessment Reform: Multi-Dimensional Dynamic Assessment

We construct an assessment model comprising four core dimensions: problem definition ability (whether vague domain needs can be transformed into computable AI problems), technology integration ability (whether AI tools are appropriately selected and applied), collaborative innovation ability (contributions and synergy in interdisciplinary teams), and ethical reflection ability (awareness of AI limitations, biases, privacy, etc.). Assessment methods integrate teacher evaluation, domain expert evaluation, peer review, and learning behavior data analysis, forming a comprehensive score that combines process and summative assessment.

3.5 Implementation Pathway and Closed-Loop Mechanism

We adopt an iterative research approach of "design – practice – assessment – optimization". The first round of practice is conducted in a small pilot class, collecting data from classroom observation, student interviews, and learning outcomes; based on feedback, the design is refined, and the practice is expanded to more classes and disciplinary combinations. After three iterations, a scalable paradigm guide and resource platform are finally developed.

4 Curriculum Reform Practice and Outcomes at Alibaba Business School

4.1 Practice Context and Setting

This study conducted a systematic curriculum reform in the Fundamentals of Artificial Intelligence course at Alibaba Business School, Hangzhou Normal University, during the 2025-2026 academic year. The school enjoys a deep industry-education integration ecosystem, maintaining close cooperation with Alibaba Cloud, Cainiao Network, and other enterprises, which provided authentic business problems, anonymized datasets, and cutting-edge technology application cases for the course. The practice period ran from September 2025 to January 2026, covering 82 students in two pilot classes of Big Data Management and Application. The 16-week course consisted of six weeks of core module instruction followed by ten weeks of interdisciplinary project-based learning.

4.2 Main Practical Outcomes

Based on this curriculum reform, the research team achieved the following concrete outcomes:

(1) Curriculum restructuring outcomes

We developed a flexible course syllabus and full set of teaching materials with a "core module + cross-disciplinary application module" structure. The core module includes six teaching units (machine learning basics, neural network introduction, natural language processing, etc.). The cross-disciplinary module developed four "AI+X" thematic cases: AI + Smart Finance (news-based stock sentiment analysis), AI + E-commerce (user review sentiment mining and recommendation optimization), AI + Bioinformatics (microscopic image classification), and AI + Digital Humanities (automatic indexing of classical texts). Each case includes a project task sheet, dataset, code framework, and teaching guide.

(2) AI-enhanced interdisciplinary project-based learning outcomes

During the ten weeks of project practice, students worked in interdisciplinary teams of 3-4 on authentic tasks. Generative AI tools (mainly DeepSeek, ChatGPT, and a locally deployed LLaMA model) were deeply integrated throughout the process. The practice covered four stages: project initiation, solution design, technical implementation, and outcome defense.

At the initiation stage, students used AI to generate literature review drafts and decompose subtasks. At the solution design stage, students used AI for brainstorming to generate multiple alternative technical routes. At the technical implementation stage, students attempted to use AI for code debugging, parameter tuning, and error explanation. At the outcome defense stage, AI simulated questions from different disciplinary experts, to which students responded accordingly. At present, the reform has produced interdisciplinary project outcomes that are being prepared for subsequent incubation with the school's partner enterprises.

(3) Teaching resource platform outcomes

An "AI + Interdisciplinary Teaching Resource Platform" was built, integrating the datasets, code repositories, teaching videos, and outstanding student works from the above four thematic cases. The platform resources will be openly shared with other schools within the university and with partner institutions.

(4) Teacher teaching community outcomes

The reform formed an interdisciplinary teaching team consisting of AI specialist teachers, business field teachers, educational technology experts, and corporate mentors. The team cumulatively conducted 12 joint lesson preparations, 4 teaching observations, and 3 workshops on AI tool usage. The team jointly formulated the Code of Conduct for AI-Assisted Learning and the Interdisciplinary Project

Evaluation Rubric.

4.3 Evaluation Methods and Data of Practical Outcomes

To systematically evaluate the effectiveness of the reform, the research team adopted a mixed-methods approach, including pre- and post-course questionnaires, learning behavior log analysis, project outcome scoring, semi-structured interviews, and classroom observation.

(1) Quantitative evaluation results

A paired-samples t-test on 86 students revealed the following:

Confidence in using AI to solve cross-domain problems (5-point scale): mean pre-score 2.87, post-score 3.81, an increase of 32.6% ($p<0.01$).

Perceived interdisciplinary team collaboration efficacy (5-point scale): pre 3.02, post 3.88, an increase of 28.4% ($p<0.05$).

Proficiency in using AI tools (5-point scale): pre 2.43, post 4.12, an increase of 69.5% ($p<0.001$).

Sensitivity to AI ethical issues (5-point scale): pre 2.91, post 4.03, an increase of 38.5% ($p<0.01$).

Regarding final interdisciplinary project comprehensive scores, the pilot class achieved an excellence rate (score ≥ 80) of 79.1%, significantly higher than the traditional control class (lecture-based + independent assignment mode) at 61.3% ($\chi2=4.82$, $p<0.05$). The student evaluation score for course teaching quality averaged 92.4 out of 100, an increase of 8.7 points compared to the same course in the previous academic year.

(2) Qualitative evaluation findings

Based on semi-structured interviews with 20 students and 4 teachers, the following themes were extracted:

Student perspective: 90% of interviewed students believed that “AI as a collaborator” lowered the technical threshold, allowing them to focus on the business problem itself; 85% indicated that the interdisciplinary team experience changed their perception of their own major and stimulated a willingness to transfer learning.

Teacher perspective: All interviewed teachers recognized the efficiency improvements brought by AI tools in personalized tutoring and case generation, but noted “the cost of supervising students’ over-reliance on AI” and “increased assessment workload” as major challenges.

Classroom observation records: In 12 project-based seminar sessions, the average frequency of students actively using AI for solution iteration was 4.3 times per group per session, significantly higher than the frequency of seeking teacher help (0.8 times per group per session) in traditional classrooms.

(3) Resource platform usage data

The platform recorded over 8,600 visits, with an average student dwell time of 12.4 minutes per visit. The AI teaching assistant module achieved a problem resolution rate of 78.5% (user-rated). The most frequent types of student questions were, in order: code debugging (42%), algorithm principle explanation (31%), project idea expansion (18%), and ethical issue consultation (9%).

5 Discussion and Conclusions

5.1 Core Conclusions Based on Practical Outcomes

Based on the above practical outcomes and evaluation data, this study draws the following core conclusions:

Conclusion 1: The AI-empowered interdisciplinary integrated teaching paradigm significantly enhances students’ comprehensive abilities. Pre- and post-course data show statistically significant improvements in all four dimensions: confidence, collaboration efficacy, tool proficiency, and ethical sensitivity. Notably, the 69.5% increase in “proficiency in using AI tools” indicates that immersive, task-driven integration of AI is far more effective than merely explaining technical principles.

Conclusion 2: The synergy between interdisciplinary project-based learning and generative AI tools is a key mechanism driving effectiveness. Qualitative data reveal that AI not only acts as an “intelligent collaborator” filling gaps in students’ knowledge, but more importantly breaks the traditional power structure dominated by technical members in teams, encouraging non-technical students (e.g., accounting, e-commerce majors) to voice domain insights and fostering genuine interdisciplinary dialogue. This finding echoes the “AI as collaborator” theory of Mollick and Mollick [9] and provides empirical support from a Chinese higher education context.

Conclusion 3: Although it increases workload, multi-dimensional process assessment is indispensable for promoting deep learning. The significant improvement in project outcome excellence rates (79.1% vs. 61.3%) is partly attributable to the assessment system’s comprehensive evaluation of problem definition, technology integration, collaborative innovation, and ethical reflection. Students stated in interviews that “knowing every step will be assessed, we took the validation and revision of AI-generated content more seriously”.

Conclusion 4: Industry-education integration-based curriculum reform has stronger sustainability and radiating value. The enterprise resources of Alibaba Business School, Hangzhou Normal University, provided authentic data and scenarios for the projects, giving student project outcomes a promising prospect of further enterprise attention, demonstrating the replicability of the school-based practice model.

5.2 Future Research Directions

Despite the positive results, this study has limitations. Future research can proceed in the following directions:

(1) Expanding sample scope and cross-disciplinary validation. The current practice focused on students with business backgrounds. Future studies should conduct cross-university comparative experiments in science and engineering (e.g., computer science, electronics), humanities and social sciences (e.g., Chinese language, history), and medicine, to examine the adaptability and boundary conditions of the paradigm across different disciplinary cultures.

(2) Conducting longitudinal follow-up studies to assess transfer effects. At present, only one-semester immediate outcome data are available. Future research should track students’ AI application behaviors in subsequent specialized courses, graduation projects, and employment, to examine the durability and transferability of “interdisciplinary innovation literacy”.

(3) Exploring the application of AI agents in personalized project guidance. The current AI teaching assistant module mainly uses question-answering interaction. Future work could introduce multi-agent systems with task planning, resource recommendation, and process monitoring capabilities, to realize a true “AI virtual tutor” and further reduce teacher workload.

(4) Building cross-institutional collaborative teaching communities and sharing ecosystems. Based on the resource platform developed in this project, a “Yangtze River Delta AI General Education Alliance” could be initiated, uniting multiple universities to co-construct and share case libraries, evaluation rubrics, and teacher training systems, advancing from single-course reform to regional teaching innovation.

(5) Research on “meta-paradigm” to cope with rapid AI technology iteration. The specific models used in this paper (e.g., DeepSeek) may be replaced by more advanced tools, but principles such as “critical use of AI”, “boundaries of human-AI collaboration”, and “ethical reflection” are durable. Future research should investigate how to construct a “technology-agnostic” meta-teaching paradigm that can dynamically adapt to emerging AI capabilities.

6 Concluding Remarks

This study, responding to the urgent need for reforming the university Fundamentals of Artificial Intelligence course and grounded in the curriculum reform practice at Alibaba Business School, Hangzhou Normal University, has constructed and validated a new paradigm of AI-empowered interdisciplinary integrated teaching. Through detailed presentation of practical outcomes, systematic evaluation data analysis, and in-depth discussion, the paper demonstrates that this paradigm can significantly enhance students’ confidence in using AI for cross-domain problem solving, collaboration efficacy, and project outcome quality. At the same time, the study reveals implementation challenges and proposes specific future directions for teaching reform. In an era where AI is profoundly reshaping education, promoting the paradigm shift from “teaching AI” to “teaching with AI” is essential for cultivating versatile innovative talents capable of harnessing the future. The paradigm guide and open resource platform developed in this study are intended to be shared with peers nationwide, jointly advancing the innovation and development of AI general education in higher education.

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