Higher Education Research
2023; 8(6): 214-219
http://www.sciencepublishinggroup.com/j/her
doi: 10.11648/j.her.20230806.11
ISSN: 2578-9341 (Print); ISSN: 2578-935X (Online)

Research on Projects Case Teaching Mode for Artificial Intelligence

Yi Yang*, Dekuang Yu

Biomedical Engineering School, Southern Medical University, Guangzhou, China

Email address:
yiyang20110130@163.com (Yi Yang), yudeku@163.com (Dekuang Yu)

*Corresponding author

To cite this article:
Yi Yang, Dekuang Yu. Research on Projects Case Teaching Mode for Artificial Intelligence. *Higher Education Research*. Vol. 8, No. 6, 2023, pp. 214-219. doi: 10.11648/j.her.20230806.11

Received: November 5, 2023; **Accepted**: November 15, 2023; **Published**: November 17, 2023

Abstract: With the background of promoting the construction of new engineering disciplines and the development of artificial intelligence technology in the global wide, and in response to the current situation of the teaching system construction of artificial intelligence courses, this paper analyzes the problems in the current teaching process, such as the disconnection between teaching content and industry positions, insufficient teaching resources and low quality, and the relatively homogenized teaching implementation and evaluation methods. After findings of that combining the current needs of artificial intelligence technology positions and application development, this paper proposes a reform plan for the teaching of artificial intelligence courses. In response to the fragmentation of practical teaching cases, low market adaptability, innovatively carry out case construction for majors, students, and industries, to follow up with the rapidly evolving artificial intelligence technology and job requirements, and solve the problem of insufficient teaching content. In the implementation of teaching, student-centered, problem-driven, and project-oriented approaches are emphasized to address the issues of teaching detachment from practice and limited learning hours. The integration of engineering training objectives with teaching practice is promoted through the construction of a feedback and adjustment mechanism for case teaching quality and a multi-dimensional evaluation plan for teaching effectiveness, thereby improving course effectiveness.

Keywords: Artificial Intelligence, Project Cases, Student-Centered, Problem Driven, Project Oriented Teaching Method

1. Introduction

The rapid development of artificial intelligence (AI) and IT technology has put forward a demand for the cultivation of composite and innovative talents in higher education. Against the backdrop of the rapid development of the new economy characterized by new technologies, new formats, new industries, and new models, China's engineering education urgently needs to cultivate diversified and innovative scientific and technological talents, and new engineering research is becoming the mainstream of innovative reform in engineering education [1]. In the context of "New Engineering" and "Innovation and Entrepreneurship Education", the artificial intelligence course is currently a key course for engineering majors [2]. It is characterized by intelligent technology, emphasizes hands-on practical skills, and cultivates senior professional and technical talents with innovation and entrepreneurship awareness and lifelong learning ability.

Since artificial intelligence is a newly established undergraduate professional course, there are many challenges in the teaching process, and there are currently few mature teaching and research achievements. Therefore, conducting research on the teaching mode of artificial intelligence is of great significance [3].

2. Existing Problems of AI Teaching

2.1. Teaching Content Disconnected from Industry Requirements

The job requirements, business, content, and ability requirements of enterprises change frequently, and most teachers do not conduct sufficient market research and job demand analysis when designing teaching cases. They

mainly analyze the course knowledge points, design content, and corresponding exercises by themselves, which often lacks real application scenarios, making it difficult to grasp the core ideas and main technologies, resulting in students being unable to apply the knowledge they have learned to solve complex engineering problems [4].

2.2. Poor Quality of Teaching Cases

The cases involved within the school are mainly designed independently based on the needs of knowledge points, and the cases are separated from each other [5]. They fail to consider the knowledge correlation and connection between different chapters, course groups, and majors, resulting in fragmented cases and isolated technical points, making it difficult for students to master the comprehensive ability to solve complex engineering problems.

2.3. Teaching Implementation and Evaluation Methods Relatively Monotonous

The current teaching of artificial intelligence courses is mainly carried out on class under the guidance of teachers on campus. At the end of the course, students submit code and documents for homework, conduct demonstrations, and defend themselves. Throughout the entire process, the guidance and evaluation methods were relatively monotonous, resulting in a disconnect between students' practical abilities and the requirements of the enterprise [6]. It is difficult for students to quickly integrate into the enterprise and carry out work after graduation.

In response to the above issues, to achieve the training objectives, there is an urgent need to reform the teaching mode of artificial intelligence courses, establish teaching content, resources, and methods that meet the needs of enterprises.

3. Educational Reform Plan and Measures

In terms of content design, combined with real enterprise projects and university research projects, a set of teaching cases suitable for the classroom based on actual projects should be designed to address the balance between the foundational and cutting-edge needs of the curriculum;

In terms of teaching implementation, we adhere to the teaching philosophy of "student-centered" and adopt problem-oriented case-based teaching, guiding students to engage in "immersive" project development in real application scenarios, allowing them to be exposed to the latest technology and complete projects, enhancing learning interest, and solving the problems of insufficient practical ability cultivation [7];

In terms of extracurricular practice, guide and assist students in carrying out innovative and entrepreneurial practices, improve their technological application and innovation abilities, and solve the problems of limited academic hours and knowledge "fragmentation" between courses [8].

3.1. Professional and Industry-Oriented Content Specifications

Based on the training objectives, teachers sort out the curriculum system and syllabus, and organize the curriculum knowledge map; Furthermore, due to the interdisciplinary nature of artificial intelligence, teachers need to delve into the connection issues between different courses involved, such as computer architecture, algorithms, data structures, programming languages, operating systems, databases, networks, etc., to eliminate repetitive knowledge point explanations, highlight mainstream and important knowledge and technology points, and form a complete, consistent, and interconnected knowledge system.

There are two issues that need to be addressed here. Firstly, in recent years, new technologies for artificial intelligence applications have emerged, and the computing platforms and programming modes of artificial intelligence are rapidly developing. The content of teaching courses needs to undergo significant changes, such as big data platforms such as HADOOP and SPARK, collaborative computing, deep neural network programming frameworks such as Tensorflow and Python. Knowledge technology is rapidly evolving, and we plan to revise it every other year to better adapt to the "future" training requirements [9].

Secondly, due to the involvement of different courses in the content, the order of courses in the curriculum system is not entirely the same for different majors, and the differences and correlations in knowledge and technology coexist, making the already limited class hours even more insufficient. This article proposes a project-oriented teaching approach that is student-centered and problem-driven. Project-based case teaching presents practical engineering needs and application scenarios, as well as the integration of mainstream technologies. Through comprehensive project case teaching, it alleviates the problem of cross course knowledge fragmentation, improves students' ability to analyze and solve problems, and solves problems with limited class hours.

3.2. Case Construction for Technology and Students

Artificial intelligence application courses need to reorganize teaching content such as programming methods, artificial intelligence algorithms, and software engineering management, and use project case teaching to encourage students to imitate learning, rather than explaining separate knowledge points. Construct project cases based on the corresponding practical ability goals of the course group. Based on the supporting role of course knowledge points, the project cases are divided into chapter cases oriented towards the course. Unified planning and design of course case resources, connecting all cases into an organic sequence according to the connection relationship of the course [10]. The cases constructed in this way not only maintains the typicality and diversity of course content, but also ensures the integrity and internal correlation of the content.

Determine typical cases based on market job requirements as the source of project cases, and use case scenarios to correspond to the comprehensive application of theoretical knowledge [11]. Divide the project cases into modules from simple to complex, to design each chapter case. Chapter cases are both relatively independent and interrelated, and the knowledge points corresponding to the required abilities for chapter cases are supported by course groups. Effective and segmented connection from easy to difficult is carried out between cases at the same level according to the module and capability requirements of each case level [12]. Write a detailed case user manual for each case, set certain thinking questions in the case analysis section, and set up group discussions to stimulate students' initiative. During the execution of case teaching, invite enterprise technical experts to participate in classroom discussions and guidance, achieving process management and joint evaluation of teaching quality between schools and enterprises.

Each project case is designed from three levels: knowledge, ability, and cognition.

At the knowledge level, the most basic requirement of the course teaching content is to teach some knowledge. The knowledge of artificial intelligence application courses mainly includes software design and development process, system design, algorithm design and optimization, graphical user interface.

At the level of ability, it is hoped that students will develop various abilities based on learning knowledge, such as program design and code debugging skills, improve expression skills by writing project development documents, and cultivate collaborative abilities through project development discussions and technical exchanges.

At the cognitive level, the highest requirement of course teaching, application cases enhance students to understand the serviceability of software, the reliability of programs, can analyze and solve problems, and have ideological and political education in the course.

The course team has developed 20 project-based teaching cases, including courseware, documents, and source code, for students to refer to for learning. Typical cases are shown in Table 1.

Table 1. *Project cases.*

Case Name	Corresponding chapters	Knowledge points
Turing test	Introduction	How to determine whether a machine has intelligence
Respiratory System Knowledge Graph	Knowledge graph	Method of Establishing a Knowledge Graph
Gene module sequencing	Search solver	Blind search
Analysis of coronary heart disease characteristics	Search solver	Heuristic search
Coronary heart disease risk assessment	Machine learning	Decision tree algorithm Support vector machine algorithm Logistic regression algorithm K-proximity algorithm
Medical Image Recognition	Artificial neural network	BP, CNN, TNN neural networks
Electronic Medical Record Entity Recognition	Artificial neural network	LSTM, sequence model

The main purpose of case teaching is for students to master professional knowledge and improve practical abilities. Based on the expected goals of the course, evaluate students' learning outcomes from the aspects of teaching effectiveness assessment, student self-evaluation, and employer evaluation, construct a three-in-one assessment mechanism, improve the effectiveness of case construction, and guide the continuous updating of cases.

3.3. Teaching Implementation: Problem-Driven and Project-Oriented

The course is based on combining theory with practice, blended online and offline teaching, and flexible organization of teaching content. The project cases designed by the course team are not limited to specific technologies, development environments, and methods. In the teaching, one or several project cases can be selected, and many cases are provided for students to reference and learn. Previously, guided by the project, the instructors provided multiple cutting-edge hot topics of academic and industrial concern after the completion of the course's basic knowledge teaching. Students spontaneously selected topics and formed teams to participate in specific projects. Each team collaborated to complete current situation research, problem formalization, technical route formulation, project design and implementation, and at the end of the course, presented and exchange experience of the project results. The specific teaching process is shown in Figure 1.

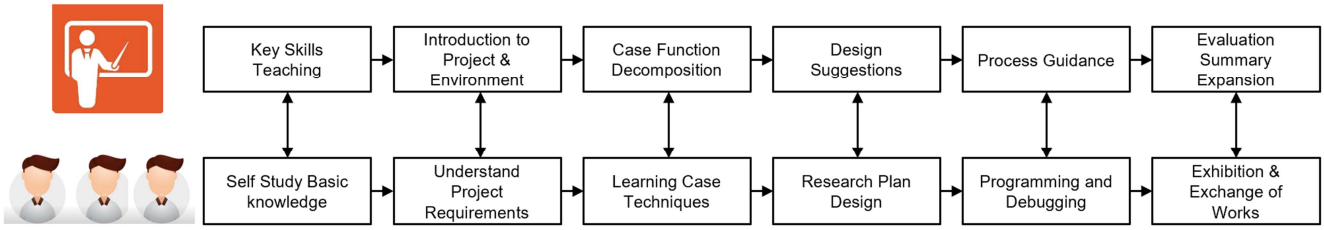

Figure 1. *Project Case Teaching Process.*

Focusing on students and targeting different majors according to different standards, targeted teaching can be carried out for different objects. The teaching content can be scientifically divided and itemized, which can improve teaching quality and effectiveness. According to the learning foundation and learning ability, students are divided into three levels: beginner, middle, and senior. Corresponding project cases and chapter cases with different difficulty levels supported by the same course group are designed [13]. Cases with different difficulty levels should be used for students at different learning levels during the implementation of case teaching. To teach students according to their aptitude, provide opportunities for students at different levels to engage in hands-on case learning, and improve their completion of case studies.

Student topic selection is not limited to the development environment or language. The process management simulation software engineering of project development is simplified into four steps suitable for simulating practical teaching: Requirements Analysis, Outline Design, Detailed Design, and Project Summary. Students use smart medical cases as reference to design and implement their own group projects, and write project documents according to specifications. Through website Q&A, interactive communication, and other forms, master technology while exercising collaboration skills.

After completing the projects, students can further summarize and improve them into research papers. Through such training and simulation of practical development based on the standardized project development process of enterprises, students' comprehensive practical ability, innovation awareness, and team collaboration ability can be effectively improved. In addition, teachers can explain their research fields and ongoing research projects to students in the classroom, and guide interested students to participate, thereby helping teachers promote their research projects and the implementation and application of research results, truly achieving mutual promotion between teaching and research.

By utilizing modern teaching methods, the campus curriculum is based on the "MOOC Classroom" on the MOOC website of Chinese universities. Teachers can flexibly use MOOC resources to improve SPOC teaching effectiveness according to the situation of their class students. Students can selectively learn by watching project case videos and independently selecting application fields of interest. SPOC teaching is conducted through universal platforms such as QQ Group, Tencent Meeting, Classroom Dispatch, etc. Provide videos, source code, and related documents, allowing students to learn about project case development processes, related technologies, and project development processes [14].

Based on the online course platform, the focus of the course is on demonstration case explanations and student group topic discussions [15]. The extracurricular focus is on project acceptance and experience exchange, with each stage forming a closed-loop management.

Teachers of the curriculum team need to design and develop project-based teaching cases for various needs and application scenarios and technologies to ensure the comprehensiveness of teaching content, and need to convert scientific research projects into teaching cases to ensure the progressiveness of teaching content [16]. They manage to provide enough cases to ensure the richness of case types, such as multimedia, website, mobile application, network and communication, big data, artificial intelligence, and algorithm. Project case-based teaching forms a system for each case within the overall knowledge system, helping students establish their own knowledge system.

Project case teaching can impart the results of teachers' research projects to students and assist them in starting their thinking on innovation and entrepreneurship as soon as possible. From the students' perspective, first they try to imitate project cases, and then attempt to raise, analyze, and finally, solve problems. By designing their own group projects, students can think and practice. The project case design is continuously updated annually, tracking the latest technological design and project cases, which is beneficial for the evolution of students' knowledge system.

3.4. Implementation Effect Evaluation and Continuous Update of Cases

Evaluate students' comprehensive abilities from the following four aspects.

Technology application ability: By learning and demonstrating project cases, able to design and implement new projects; Master the methods of analyzing and solving problems.

Collaborative ability: Require students to collaborate in small groups to complete projects with the communication and interactive learning situation on online platforms such as local SPOC platform and online classroom.

Expression ability: Write project documents according to software engineering project specifications; Provide a project summary and presentation speech at the end of the term.

Social responsibility: Add ideological and political related projects to the design of teaching project cases; Guide students to create targeted questions when selecting group topics.

Project practice is with equal emphasis on results and process, so performance evaluation should fully consider the stage results. Process assessment accounts for 50%, requiring the writing of project documents in accordance with process management, including requirement analysis (15%), architecture design (10%), detailed design (10%), and project implementation (15%); The final presentation accounts for 50%, and a detailed assessment of the work is conducted including completeness of the results (10%), practicality of the project (10%), technical difficulty (10%), group division and cooperation (10%), and on-site reporting effectiveness (10%).

After the implementation of teaching in four teaching cycles from 2019 to 2022, students have completed a variety

of projects, as shown in Table 2.

Table 2. *Students' Achievements.*

Year	Corresponding chapters
2019	Hospital Public Information Management System
2019	Medical Course Selection Information Management System
2019	Medical Student Evaluation Information Management System
2019	Student Achievement Information Management System
2019	Graduate Information Management System
2020	learning Team Building Information Management System for Medical and Health Systems
2020	Department Doctor Information Management System
2020	Online Q&A Information Management System
2020	Outpatient Registration Information Management System
2020	Medical Image Processing System
2021	Chinese Medical Record Intelligent Analysis System
2021	Hospital Teaching and Training Information Management System
2021	Remote Medical Image Transmission System
2021	Cross Provincial Medical Expense Settlement System
2021	Course Question Bank Management System
2022	Medical News Release Review Information Management System
2022	Hospital Notification Release and Review Information Management System
2022	Medical Equipment Consumable Information Management System
2022	Hospital Library Information Management System
2022	Medical Paper Information Management System
2022	Provincial Medical Research Project Information Management System
2022	Medical Practice Course Topic Information Management System

The excerpts of students' gains and experiences are as follows.

"I have gained a lot from studying artificial intelligence courses. My classmates and I made a small software ourselves this term. Although there were still many problems in the software, we gained a lot of knowledge from it. Not only did we have gained professional knowledge, but it also made me understand that every step of a software from design to implementation is not easy. Not only does it require solid professional knowledge, but also the cooperation of a team, this is the key to the success of a project. This tells us that a person's excellence is nothing, and a team's excellence is truly useful."

"In the experimental class, I learned many methods. And this is the most practical in the future. To face the challenges of society, one must constantly learn, practice, and then learn and practice again. In the future, no matter how hard it may be, I think I can find interesting things, and discover precious things within them. I become more mature after the experiment is over, face the things that need to be faced, and learn to solve problems slowly without being anxious."

"During the design process, divide the work with classmates, discuss with each other, learn from each other, and supervise each other. I have learned to cooperate, to be tolerant, to understand. Course design is a practical training for the comprehensive application of our professional course knowledge, and it is a necessary process for us to enter society and engage in professional work. During the experiment, I am also very grateful for the guidance of the experimental instructor."

"The AI course study is not only a comprehensive process of the knowledge learned this semester, but also an improvement of one's hands-on ability, enhancing one's practical ability. Through this course, I have come to understand that learning from textbooks is still far from enough. There are still too many things that I do not know, and learning requires long-term accumulation. In the future, I should constantly learn, combine the theoretical knowledge of textbooks with practical knowledge in life, and continuously improve my cultural knowledge and practical abilities."

4. Conclusion

The case-based teaching mode of artificial intelligence projects not only allows students to quickly access the latest technology and complete projects, but also combines scientific research projects, school enterprise cooperation projects, and curriculum ideological and political education to assist students in starting their thinking on innovation and entrepreneurship as soon as possible.

Content innovation: The course focuses on the development of AI theory and technology, integrating classic principles and the latest technologies. Guided by application needs, teaching cases are established based on industry projects, and structural reconstruction is carried out in combination with teachers' research projects and school-enterprise cooperation projects, achieving real-life teaching and training.

Model innovation: Based on the student-centered approach, layered design of content and teaching methods, combined with online resources for campus SPOC teaching, meeting the varying degrees of learning requirements of different students, and achieving personalized teaching.

Practical innovation: Various forms of extracurricular technical activities for students have been carried out, and engineering process management has been adopted to achieve expanded course space and advanced teaching forms.

The achievements of curriculum construction have supported the engineering certification of related majors, and received recognition from experts. In the future, we will continue to practice the integration of science and education, industry and education, and theory and practice. Our professional courses will go hand in hand with ideological and political courses, cultivating students' patriotism and industry spirit oriented towards professional characteristics. We will continuously update teaching project cases and keep up with the pace of the times and the speed of technological development.

Funding

This work was supported in part by the Teaching Quality and Teaching Reform Project of Southern Medical University in 2021 (Artificial Intelligence Basic Course Teaching and Research Office, ZL202141), and the Higher Education Teaching Reform Project of Southern Medical University in 2021 (Exploration and Practice of Innovative Talent Training and Upgrading Paths for "Artificial Intelligence Biomedical Engineering", JG2021066), The research project of the Guangdong Province Undergraduate University Online Open Course Guidance Committee in 2022 (Research on Hybrid Teaching Design Based on Online Open Course Optimization and Interactive Learning, 2022ZXKC082), and the Ministry of Education's Industry University Collaborative Education Project (Artificial Intelligence Basic Experimental Case Design, 220901636155236), 2023 Southern Medical University Degree and Graduate Education Reform Research Project (Research on the "Project Case" Teaching Model for Biomedical Engineering Graduate Students Guided by Applied Innovation Ability).

ORCID

Yi Yang: 0000-0001-5333-6649
Dekuang Yu: 0009-0009-5217-0232

Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] B. J. Zou, X. Y. Kui, X. N. Peng, et al. “A New Way to Enhance the Innovative Practice Ability of College Students,” Computer Education, pp. 1-5, March 2022.

[2] M Jia., W. W Shi., X. F. Lu, et al. “Artificial Intelligence Innovation Practice Course Ideological and Political Teaching in the Context of Technological Innovation in the New Era,” Computer Education, 2022 (8), pp. 48-52, August 2022.

[3] Z. F. Gao, J. L. Li, J. C. Zhang, et al. “Reform of blended teaching in engineering training courses,” Modern Education Forum, pp. 47-49, December 2022.

[4] Z. H. Zhou. The Undergraduate Education and Training System of Artificial Intelligence at Nanjing University. Beijing: Mechanical Industry Press, 2019.

[5] S. M. He, J. T. Liu. “New Research on Hybrid Teaching Models in Universities: A Review of "Research on Hybrid Teaching Models in Universities from a Personalized Perspective",” Chinese Journal of Education, pp. 123, July 2022.

[6] X. Y. Wang, S. H. Zhang, M. L. Wang. “Practice of blended teaching in college physics based on process management and assessment,” Physical Bulletin, pp. 25-29, November 2022.

[7] T. Chen. “Exploring the ‘Online Offline’ Hybrid Teaching of Information Theory and Coding Course Based on Problem Guided Approach,” Journal of Higher Education, pp. 132-135, August 2022.

[8] J. Liu, H. B. Liu, J. L. Jia, et al. “A Practical Exploration of the Mixed Discussion Teaching Method in Online Teaching,” Management Engineer, pp. 76-80, February 2022.

[9] H. Liu. “A Study on the Hybrid Teaching Model of Professional Courses Guided by Practical Project Cases: Taking the Introduction to Intelligent Control Course as an Example,” Computer Education, pp. 114-118, April 2020.

[10] Q. P. Pu, H. M. Lei, X. Y. Wang. “The Triple Logic of New Engineering Construction from the Perspective of New Development Stage, New Development Concept, and New Development Pattern,” Journal of Chongqing University (Social Science Edition), pp. 160-170, April 2021.

[11] Z. F. Liao, J. Wang, B. Xiong. “Research on the Teaching and Practice Reform of Software Engineering Course in the Context of New Engineering,” The Computer Age, pp. 81-83+87, May 2021.

[12] N. Yang, T. Li. “Construction and Practice of the One Body, Two Wings Teaching Model in Software Engineering from the Perspective of Case Teaching,” Higher Engineering Education Research, pp. 177-181, January 2020.

[13] W. Q. Su. “On Innovative Approaches to Computer Software Engineering Management in the New Era,” Digital Communication World, pp. 132-134+137, August 2022.

[14] L. P. Zhou, F. Zhou, Y. B. Chen. “Research and Construction of Software Engineering Professional Practice Course Platform under the Background of Engineering Certification,” China New Communications, pp. 77-78, September 2021.

[15] P. Bao, W. W. Xing, W. Lu, et al. “The Teaching Model of Artificial Intelligence Practical Courses in the Context of New Engineering innovation research,” Computer Education, pp. 105-109, June 2021.

[16] Y. Liu Yong, Q. X. Hu. “On the Future Development of Artificial Intelligence Education: From the Perspective of Discipline Construction,” China's Audiovisual Education, pp. 37-42, February 2020.