Curriculum and Teaching Methodology (2024)
Clausius Scientific Press, Canada

DOI: 10.23977/curtm.2024.070612
ISSN 2616-2261 Vol. 7 Num. 6

Curriculum Reform and Teaching Methodology for Project-Driven Machine Learning Course in the Context of New Engineering

Na Lu[1,a,*], Xiaomin Zhang[1,b]

[1]Wuhan Technology and Business University, Wuhan, China
[a]20210101021@wtbu.edu.cn, [b]zhangxiaomin@wtbu.edu.cn
[*]Corresponding author

Keywords: New Engineering; Machine learning; Project driven

Abstract: With the rise of new engineering education and the rapid development of artificial intelligence technology, the traditional machine learning course teaching mode can no longer meet the current educational needs. On the basis of analyzing the current teaching situation, this article proposes a project-based machine learning course teaching reform plan, aiming to cultivate students' practical ability and innovative thinking to meet the demand for engineering and technical talents in the new era.

1. Introduction

Driven by globalization and technological innovation, the demand for new engineering talents in society is increasing day by day. Facing the strategic goal of national modernization in the mid-21st century, it has become crucial to cultivate high-quality engineers with innovative and practical abilities[1]. The current engineering education model needs to keep pace with the times and carry out teaching reforms. As the core of new engineering education, machine learning's teaching reform is crucial for enhancing students' comprehensive literacy[2]. This article explores the teaching reform of project-based machine learning courses in the context of new engineering disciplines, aiming to cultivate students' engineering awareness and problem-solving abilities through practice oriented teaching strategies, meet the talent needs of the industry, and achieve effective integration between education and social demands.

2. Analysis of the current situation of Machine Learning Teaching

Machine learning, as a core technology course in the field of artificial intelligence, combines high theoretical and practical aspects. If students fail to form a comprehensive understanding of algorithm principles, data processing, model training, and evaluation in the course, it will directly affect their learning effectiveness in subsequent courses such as deep learning, natural language processing, image recognition, etc. It will also limit students' ability to solve complex problems in practical applications and affect their overall academic and career development in the field of artificial intelligence[3-6]. However, there are still the following issues in current machine learning course teaching.

2.1 The teaching content is not closely integrated with the forefront of the industry

At present, the content of machine learning courses often focuses on basic theories and classical algorithms, and is not closely integrated with the latest technological trends and application scenarios in the industry. This makes it difficult for students to directly apply the knowledge they learn to practical work and lacks the ability to solve practical problems.

2.2 Lack of emphasis on the concept of the entire project process

In teaching, there is often only emphasis on algorithm design and programming implementation, neglecting the entire process from problem formulation, analysis to solution implementation. Students lack a systematic understanding of the project from requirement analysis to final delivery, making it difficult to form a complete project development experience.

2.3 Difficult to cultivate students' interdisciplinary practical project abilities

Machine learning, as a technological tool, needs to be combined with specific disciplinary knowledge for its application in different fields. However, in the existing teaching system, students often find it difficult to gain practical experience in effectively integrating machine learning technology with specific domain knowledge. This cross disciplinary knowledge integration ability is crucial for solving practical problems, but students' insufficient training in this area limits their development of comprehensive practical skills when applying machine learning techniques in multiple fields.

2.4 The learning evaluation system has not been standardized

The existing evaluation system mostly focuses on the mastery of theoretical knowledge, lacking a comprehensive assessment of students' practical ability, innovative thinking, and project solving ability. This makes it difficult for students to receive comprehensive and objective evaluations during the learning process, which affects their overall ability improvement.

3. Reform Measures for Machine Learning Teaching

In response to the above teaching situation, the following teaching reform measures can be mainly taken.

3.1 Building an interdisciplinary advantage team

Build a professional team composed of teachers from different disciplines, including but not limited to computer science, statistics, applied mathematics, domain engineering, and other industry teachers or experts. Through this interdisciplinary teamwork of teachers, students can be provided with a multi-perspective and all-round learning perspective. Teacher team members can share their professional knowledge and industry experience, jointly design and implement course content, integrate perspectives and methods from different disciplines, provide students with richer and more three-dimensional learning experiences, and ensure that teaching is both in-depth and professional, while also covering the application of machine learning technology in different fields.

This teamwork model not only improves the quality of teaching, but also helps students establish interdisciplinary thinking and lay a solid foundation for solving complex real-world problems. Interdisciplinary teams can carry out regular teaching seminars, continuously optimize teaching strategies, introduce the latest research results and industry trends, and ensure the cutting-edge and

practicality of teaching content.

3.2 The basic workflow of machine learning projects is integrated

The project-based teaching design is a systematic teaching method that requires machine learning courses to cover every aspect from project planning to final delivery. This design simulates the implementation process of machine learning projects in the real world, enabling students to fully understand and participate in all stages of the project[7]. Taking the regression task as an example, its design process is shown in Figure 1.

The teaching design for the entire project process requires that the machine learning course covers every stage from project initiation to project delivery. During the project initiation phase, students will learn how to define problems, determine project goals and requirement. During the data collection and processing phase, students can master the skills of data cleaning, transformation, and visualization. During the feature selection and model training phase, students can try to extract valuable information from the data and choose appropriate algorithms to build models. During the model evaluation and result analysis phase, students learn how to evaluate the performance of the model and make adjustments and optimizations based on the results. In this complete project process teaching process, students will experience the complete process from theory to practice, understanding the importance of each step and its role in the entire project. This kind of instructional design helps students build a deep understanding of the macro and micro levels of machine learning projects, laying a solid foundation for their future careers.

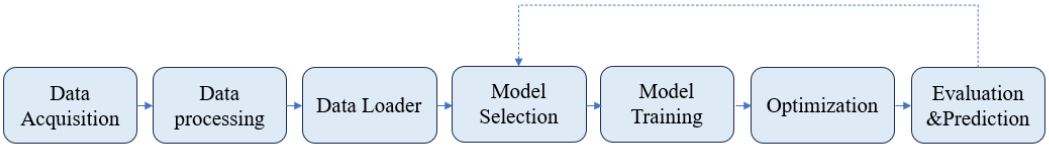

Figure 1: Regression project process design

3.3 Building interdisciplinary practice projects

Choosing practical projects that are close to application scenarios in teaching, such as public opinion analysis and prediction, water quality prediction, benign/malignant tumor judgment, second-hand car price prediction, logistics zoning, etc., may involve multiple disciplines and majors, such as computer science, statistics, environmental protection, logistics, management, etc. This project design encourages students to apply machine learning techniques to problem-solving in specific industries such as healthcare, finance, transportation, and environmental science[8]. In addition to the professional knowledge of machine learning itself, students also need to understand the basic concepts and principles of the aforementioned disciplines and apply them to solve practical problems. Through interdisciplinary practice projects, not only can students enhance their ability to apply theoretical knowledge to solve practical problems, but they can also strengthen their innovative thinking and ability to apply artificial intelligence related technologies and methods to different industries.

3.4 Based on diversified course assessment methods

In the process of promoting curriculum teaching reform, establish a student-centered teaching closed-loop evaluation process and adopt a more diversified assessment method based on curriculum evaluation indicators. The new assessment method breaks away from the conventional thinking that

the final theoretical closed book exam has the heaviest weight, and focuses on the cultivation of students' learning and practical abilities in their daily lives[9]. The scoring is based on teacher evaluation, statistical data from the teaching platform, and teacher-student mutual evaluation. The specific content of the assessment items, methods, scores, and other score components is shown in Figure 2.

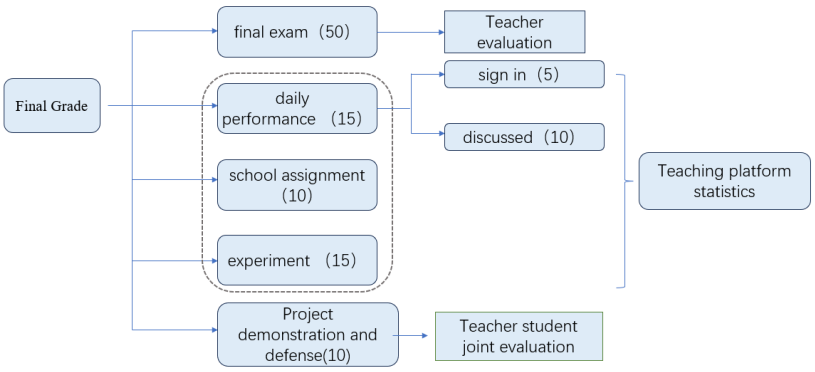

Figure 2: Diversified assessment methods

Compared to the previous assessment method, the main changes are as follows: a) The homework format for daily grades has increased to include online interactive discussions. Online interactive discussions mainly introduce cutting-edge technology in the industry, the application of learned knowledge in industry scenarios, etc. The main purpose is to hope that teaching can keep up with the forefront of the subject environment, expand the integration of teaching with other disciplines, encourage students to broaden their horizons, increase reading, stimulate students' active thinking, and stimulate the learning atmosphere. b) Increase the proportion of experimental results and highlight the cultivation of project practical abilities. And in terms of experimental scoring, more emphasis is placed on the expansion of thinking in project design and problem-solving, encouraging open thinking to use one's own knowledge to horizontally compare and solve problems, rather than just scoring based on the final results.

In the project demonstration and defense stage, we will change the traditional scoring criteria based on practical results, emphasize the investment of students in each stage of project practice, and form a complete project document system. The scoring criteria for project practice are shown in Table 1.

Table 1: Scoring criteria for project practice

No.	Indicator	Dimension	Score
1	Modeling	Model performance evaluation Model stability	20
		Model selection	10
		Model traing	10
2	Data Management	Data collection Cleaning&Organization	20
3	Programming Skills	Clear code logic Easy to maintain code	20
4	Conclision Analysis	Evaluation resulst	10
		Summary	10

4. Conclusion

In the context of new engineering education, the teaching reform of machine learning courses is particularly important. Through in-depth analysis of the current teaching situation, this article proposes a series of reform measures, including strengthening interdisciplinary team building, implementing full process project teaching, constructing interdisciplinary practice projects, and establishing a student-centered diversified evaluation system. These measures aim to enhance students' practical abilities, innovative thinking, and promote the development of their comprehensive literacy, hoping to cultivate more high-quality talents with the ability to solve complex problems.

Acknowledgment

The work was supported by the school teaching and research projects of Wuhan Technology and Business University with the project number 2023Y18 and the project name Teaching Reform of Machine Learning Course Based on Project Practice under the Background of New Engineering.

References

[1] Zhang B, Zhang J, Zhang C, et al. Curriculum Reform and Exploration Under the Background of Artificial Intelligence and New Engineering[J]. Computer Education, 2021. DOI:10.1007/978-981-16-6502-8_22.

[2] Liu S, W J. Ice and snow talent training based on construction and analysis of artificial intelligence education informatization teaching model [J]. Journal of Intelligent & Fuzzy Systems, 2021, 40(2).

[3] Li D, Liu S. Problems and Countermeasures of Local Governments in Promoting Innovation and Entrepreneurship Education for College Students under the New Development Concept [J]. Sci-tech Innovation and Productivity, 2022(04):7-10.

[4] Li R. Analysis on the Innovation Research of the New Era College Student Entrepreneurship Team Participating in Innovation and Entrepreneurship Training [J]. Auto Time, 2021(01):24-25.

[5] Sima Sabahi, Mahour Mellat Parast. The impact of entrepreneurship orientation on project performance: A machine learning approach [J]. International Journal of Production Economics, 2020: 1-14.

[6] Ahmad K, Iqbal W, El-Hassan A, et al. Data-driven artificial intelligence in education: A comprehensive review [J]. IEEE Transactions on Learning Technologies, 2023.

[7] Lee D, Huh Y, Lin C-Y, et al. Differences in personalized learning practice and technology use in high-and low-performing learner-centered schools in the United States[J]. Educational Technology Research and Development, 2021, 69:1221-1245.

[8] Luan H, Tsai C-C. A review of using machine learning approaches for precision education[J]. Educational Technology & Society, 2021, 24(1):250-266.

[9] Majjate H, Bellarhmouch Y, Jeghal A, et al. AI-Powered Academic Guidance and Counseling System Based on Student Profile and Interests [J]. Applied System Innovation, 2023, 7(1):6.