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Exploration of Teaching Reform in Machine Learning Courses in Applied Universities

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Abstract: This article proposes the following reform ideas for machine learning courses based on the talent cultivation goals of applied universities: optimizing course content with application as the goal; Aiming at the forefront of the discipline and innovating teaching cases; Reconstruct teaching mode with student-centered approach; Enrich assessment dimensions and improve feedback mechanisms. These reform measures aim to improve the teaching quality of machine learning courses, enhance the learning effectiveness of students, and better adapt to the demand for high-quality applied talents in the new era.

Keywords: Machine Learning; Curriculum Reform; Applied University; Student-centered.

1. Introduction

In the era of artificial intelligence, machine learning, as a core technology, is crucial for the training of professional talents. Therefore, in-depth reform of the machine learning courses in applied universities has become an urgent task. The theoretical knowledge of machine learning courses is extensive and abstract. One of the teaching goals is to enable students to apply its basic methods to solve practical application problems, and the teaching process needs to closely integrate theory and practice. Therefore, how to enhance students' ability to use machine learning to solve practical application problems, and to solidify the quality of innovative and interdisciplinary talent training, is also a problem that needs to be addressed in machine learning course teaching [1]. The application-oriented machine learning course of the university aims to enable students to apply theoretical knowledge to solve practical problems. Students need to understand the basic concepts of machine learning, master the working principles, applicable scenarios, and advantages and disadvantages of classic machine learning algorithms such as linear regression, logistic regression, decision tree, random forest, support vector machine, neural network, etc. They should be able to evaluate the applicability and effectiveness of different machine learning technologies, and fine-tune models to improve predictive performance and generalization ability. How to solve the cross-fusion of knowledge in teaching and achieve innovative applications is a common challenge.

2. Related Work

Traditional machine learning course teaching focuses on explaining mathematical basic models, deriving formulas, and implementing code, lacking introductions to the evolution process and application scenarios, insufficient expansion of extracurricular knowledge, and lack of cutting-edge and innovative aspects[2]. Bibo Lu et al.[3] analyzed the difficulties in setting up deep learning courses in universities and discussed how to set up deep learning courses under existing conditions. They also gave suggestions on integrating the construction of new engineering disciplines and the coordination of the education-industry cooperation project of the Ministry of Education to explore the opening path, model, and teacher training of deep learning. Jing Tang et al. [4] proposed a new "3M" teaching method of mathematics, mechanism, and operation to address the problems existing in machine learning course teaching, and introduced the process and effect of course reform implementation. Yuan Yuan Zeng [5] analyzed the main pain points of machine learning courses under the background of the new engineering, and proposed a teaching innovation idea system of "integration, convergence, and derivation" to explore how to design innovative teaching modes for course innovation. Yi Ying etc [6] proposed specific reform plans focusing on the interdisciplinary nature of the "machine learning" course, the rapid technological updates, and the emphasis on practical programming skills, aiming to improve the teaching effect and the cultivation of innovative and technical talents. Jie Li and others [7] proposed to design experimental cases in the field of smart manufacturing by combining students' professional research areas with a progressive principle, and introduced the experimental design, content, teaching plan, and evaluation plan of the machine learning course. Xuefeng Zhao and others [8] discussed how to reasonably arrange the theoretical teaching content, use appropriate teaching methods, design practical ways and content, and formulate assessment methods for undergraduate machine learning course construction. Ya Ru Zhang and others [9] proposed specific reform plans for the machine learning course from four aspects: updating and iterating teaching content, innovating mixed teaching modes, inspiring course experiments, and multi-dimensional assessment. Li Dong et al [10] analyzed the cognitive rules of students in the process of learning the course, and proposed a hierarchical cognitive model. Based on this model, they elaborated the methods and processes of teaching reform from the aspects of teaching content, teaching methods, and assessment methods. Bo Yu [11] proposed a blended teaching plan for the "machine learning" course, including the formulation of course objectives, design of teaching content, construction of diversified course evaluation methods, and the use of information technology to build networked course resources. Various teaching methods such as blended, problem-based, and project-based were comprehensively applied. Hong Rao et al [12] discussed the difficulties faced by universities in

offering machine learning courses such as difficult experimental environment setup, challenging teaching case design, and difficulty in obtaining industry big data sets. They explored practical teaching of machine learning courses based on the Baidu AI Studio platform, aiming to cultivate students' ability to solve complex problems in their professional field using artificial intelligence technology. Wan Lin et al [1] proposed to organize machine learning course practical teaching based on the engineering thinking of software engineering, focusing on actual engineering project requirements and introducing the design of "basic + advanced + open" practical teaching cases. They explained how to organize practical teaching based on the software engineering process.

3. Curriculum Reform Ideas and Plans

This article is based on the talent training objectives of applied universities, and proposes the following reform ideas for the difficulties in teaching content, poor applicability of teaching courseware, and relatively single assessment methods faced by the machine learning course (as shown in Figure 1): aiming at application, optimizing course content; targeting the forefront of the discipline, innovating teaching cases; focusing on students, restructuring teaching methods; enriching assessment dimensions, improving feedback mechanisms.

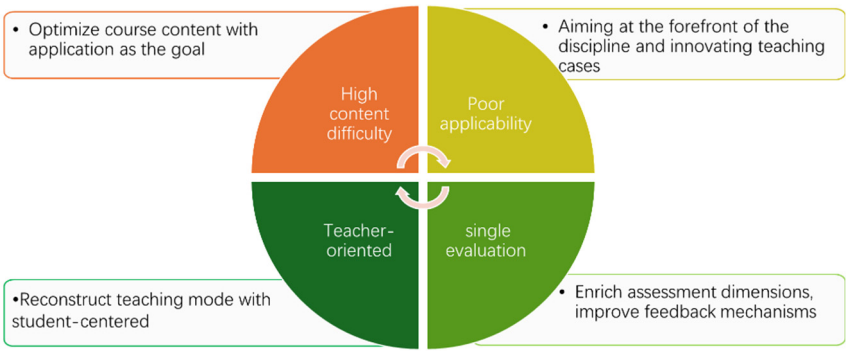

Figure 1. Reform Plan for Machine Learning Course

3.1. Optimizing Course Content with Application as the Goal

Machine learning, as an interdisciplinary subject, involves knowledge in computer science, mathematics, statistics, and other fields. Therefore, in the teaching reform, diversified course content should be designed to guide students to learn and think across disciplines, promote the cultivation of students' comprehensive abilities, improve the teaching quality of machine learning courses, and provide strong support for the cultivation of high-quality applied talents.

Traditional machine learning courses often excessively emphasize theoretical knowledge, while neglecting the cultivation of practical application abilities. Therefore, in the teaching reform, it is necessary to optimize course content, highlighting the combination of theory and practice. With the increasing demand for machine learning skills in the industrial and academic sectors, it is important to closely integrate practical application needs, integrate the latest technological trends, and update course content. By researching the latest application scenarios in the market and enterprises, focusing on machine learning algorithms and tools with high practical value, adding more practical techniques related to data processing, algorithm optimization, model training, and practical deployment, and providing a suitable amount of case analysis and project practice, students' understanding of theoretical knowledge and application abilities can be deepened through practical operation. Traditional machine learning courses are often rich and compact in content, making it difficult for students to internalize the knowledge they have learned. Therefore, in the reform of teaching, the course structure should be adjusted reasonably, emphasizing key points, reducing the accumulation of content, and focusing on the internalization of knowledge and the cultivation of application abilities. A hierarchical and progressive structure can be adopted, gradually increasing the difficulty, guiding students to gradually understand and master the basic principles and methods of machine learning.

3.2. Targeting Innovative Teaching Cases at the Forefront of the Discipline

In order to help students better understand and master machine learning knowledge, the innovation of teaching cases is crucial. The course should integrate the latest research results and technological trends of machine learning, providing cutting-edge cases that are in line with the development of the discipline, such as the latest research results and applications in the fields of deep learning, natural language processing, image recognition, etc. Through these inspiring and exploratory cases, students can have a more intuitive understanding of how machine learning technology solves practical problems. Analyzing real-world machine learning cases can not only increase students' interest in learning but also cultivate their innovative thinking and problem-solving abilities.

First, it is necessary to develop case-based teaching courseware, cooperate with enterprises to build engineering application cases, and combine the development forefront of the discipline to build advanced application teaching cases. Secondly, inviting enterprises and domain experts to hold lectures on case analysis can help students understand the latest machine learning application cases and development trends, broaden their horizons, and increase their practical experience. Finally, it is necessary to integrate internal and external resources, provide advanced and reliable experimental platforms, simplify the threshold for applying theoretical knowledge to practical problems, and improve the effectiveness of learning.

3.3. Reconstructing the Teaching Model with Students as the Center

The traditional teaching model often revolves around the teacher, adopting a lecture-based approach, which may not be conducive to student-centered learning and deep understanding. In modern educational concepts, students are the main body of learning, through implementing teaching methods such as group discussions, flipped classrooms, and project-driven approaches, encouraging students to learn independently, while the role of the teacher should also shift from the traditional "lecturer" to "guide" and "assistant." The core of reconstructing the teaching model is to stimulate students' initiative and creativity, which can be achieved through advocating inquiry-based learning, project-driven learning, and other methods to enhance students' problem-solving abilities and innovative thinking through practical operations and team collaboration, as shown in Figure 2.

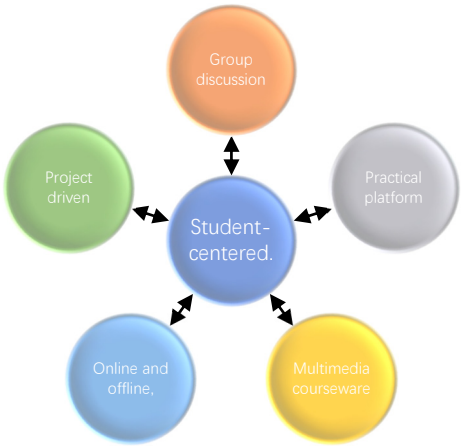

Figure 2. Teaching design for machine learning course

First, it is necessary to adopt a more flexible and diverse teaching approach. For example, using case-based teaching method, integrating practical cases in the classroom, allowing students to understand the principles and methods of machine learning through analyzing and solving practical case problems; using problem-driven teaching method, guiding students to explore and learn relevant knowledge autonomously from practical problems, and so on.

Second, new teaching methods need to be introduced. Fully utilize multimedia technology to visualize abstract machine learning theories, allowing students to understand and master knowledge more intuitively. Meanwhile, the popularity of the Internet and mobile devices also provides new possibilities for teaching. Leveraging online teaching platforms to provide a diverse range of learning resources, allowing students to learn anytime and anywhere.- In addition, students can be provided with a more realistic learning environment through virtual labs, allowing them to reinforce their knowledge through practice.

Additionally, teachers can adopt the "flipped classroom" teaching model, where knowledge is imparted outside of class, and students engage in discussion and exchange during class. This not only enhances student initiative and participation, but also makes the teaching process more efficient. Teachers can also encourage students to engage in group cooperative learning, enhancing their understanding and practical abilities through group discussions and collaboration projects. In this way, students can learn effective communication and collaboration in team work, fostering teamwork and innovation.

3.4. Enriching Assessment Dimensions and Improving Feedback Mechanisms

Innovation in assessment methods is crucial for promoting the comprehensive development of students. Diversification in assessment methods provides a more comprehensive evaluation of student learning outcomes. The assessment of the machine learning course should not be limited to traditional closed-book exams, but should introduce open-ended questions, project reports, peer assessments, and project reviews. These methods can better evaluate students' practical abilities and the comprehensive application of theoretical knowledge.

Firstly, learning assessment and evaluation methods can combine open-ended questions with practical operations. Machine learning is a highly practical subject, and students deepen their understanding and application of knowledge through practical operations. Therefore, assessment methods can include practical projects or experiments, requiring students to apply their knowledge and write lab reports or project summaries. Through practical operations, students can be assessed on their grasp of knowledge and application abilities, while also sparking their interest and motivation for learning.

Secondly, learning assessment and evaluation methods can utilize group cooperation and team projects. Machine learning is a highly interdisciplinary subject, involving knowledge and skills from multiple fields, so it can be assessed through group cooperation and team projects. Students can communicate with each other within the group, solve problems together, and cultivate teamwork and communication skills. Assessing through team projects can also examine students' ability to solve practical problems and innovate, which is in line with the goal of training students in applied universities.

In addition, a timely and efficient feedback mechanism should be established. Timely and constructive feedback can help students recognize their shortcomings in the learning process and make timely adjustments, promoting the continuous improvement of their abilities. Teachers can also adjust teaching strategies based on feedback, forming a virtuous cycle of teaching and learning.

4. Conclusion

The machine learning course of applied universities aims to help students understand the basic concepts of machine learning, master classic machine learning algorithms, and be able to evaluate the applicability and effectiveness of different machine learning technologies. Based on the talent training goals of applied universities, this article proposes reform ideas for machine learning courses: aiming for application, optimizing course content; targeting the forefront of the discipline, innovating teaching cases; focusing on students, restructuring teaching methods; enriching assessment dimensions, improving feedback mechanisms. These reform measures strengthen output-oriented content design in teaching content, take into account the characteristics of the cutting-edge cross-application of machine learning courses, and establish a diverse guided evaluation mechanism, which can improve the teaching quality of machine learning courses and better adapt to the needs of the new era for applied high-quality talents.

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