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# *Research on Teaching Reform of Machine Learning Course Based on OBE Orientation*

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***Abstract:*** With the rapid development of artificial intelligence, machine learning has become one of the most essential courses in many universities, given its importance as a core technology in this field. As a multidisciplinary subject with complex and evolving content, machine learning raises many challenges, including a lack of diversity in course materials and teaching methods, little connection between theory and practice, and traditional assessment methods. To address these challenges, it is necessary to reform and enhance the teaching of machine learning. Outcomes-Based Education (OBE) is a new learning approach that emphasizes the development of students abilities and practical skills. It can be used to improve and enhance the machine learning course curriculum. This paper investigated the difficulties surrounding machine learning education, the measures adopted to reform machine learning teaching based on the OBE concept, and strategies for promoting the reform of machine learning teaching based on the OBE approach. This study aims to improve teaching outcomes and enhance students' application skills, cultivate highly skilled professionals with practical application capabilities, and enable machine learning courses to better meet practical application needs.

## 1. Introduction

With the rapid development of artificial intelligence (AI) and big data, machine learning has become an important means of AI, which specializes in analyzing and interpreting patterns and structures of data to achieve autonomous learning, reasoning, decision-making, and other purposes without human interaction, making it increasingly important and widely applied in various fields [1-3]. However, the current teaching of machine learning-related courses in China still faces many challenges, such as a lack of diversity in course materials and teaching formats, incomplete course assessment, and insufficient integration of theory and practice [4-7]. Therefore, this paper aims to explore how to enhance the teaching effectiveness and practical application skills of students through OBE-based machine learning course reform.

OBE (Outcomes-Based Education) is an education model that emphasizes on learning outcomes, stressing the abilities and knowledge levels that students should possess [8-10]. By introducing the

OBE concept, the machine learning course is no longer limited to only theoretical explanations and practical demonstrations but prioritizes the development of students' understanding and application skills in machine learning. Therefore, students can acquire professional knowledge and skills in the field of machine learning, thus enhancing their practical application capabilities.

This paper aims to investigate the ways in which the OBE approach can be leveraged to improve teaching methods, enhance students' practical and application skills, and provide references for talent cultivation in the machine learning field.

## 2. The Dilemma of Machine Learning Teaching

### 2.1. Higher Requirements for Mathematical Foundation

Machine learning is a discipline that involves many advanced mathematical and statistical concepts, resulting in its relatively high degree of difficulty. Many students require a foundational understanding of mathematics including linear algebra, calculus, and probability theory before they can effectively pursue machine learning. These fundamental mathematical concepts form the basis of machine learning theory and provide essential support for students' theoretical comprehension and skillset. However, students who lack sufficient mathematical fluency may require additional effort and study to keep pace with the curriculum. This may result in difficulties understanding and learning new algorithms and models. Furthermore, many machine learning techniques and technologies are highly complex, requiring precise and detailed algorithmic steps, which increases the difficulty of understanding the course for students.

In addition to the requisition of advanced mathematical knowledge, machine learning also demands a significant abundance of data and computational resources, which can prove challenging for many students to acquire. Students without adequate computer and technological skills would be incapable of completing many practical assignments, forfeiting themselves the opportunities to develop and operationalize their practical skills.

### 2.2. A Lack of Diversity in Teaching Formats

A significant challenge in machine learning education is the prevalence of a limited diversity of teaching formats. Firstly, due to the complexity of the discipline, students require both theoretical and practical training in order to thoroughly comprehend its various algorithms and technical principles. Solely relying on classroom lectures and demonstrations cannot provide an in-depth understanding nor mastery of practical skills. Furthermore, machine learning is a rapidly evolving field, with emerging technologies and updated algorithms demanding prompt adaptation in teaching materials to ensure that students grasp the most cutting-edge and relevant techniques. A restrictive approach to teaching formats detracts from teaching efficiency and makes it difficult to keep up with pertinent innovations. Finally, the high level of difficulty of machine learning coursework can lead to a decline in student interest and motivation, eventually coalescing into academic fatigue and psychological stress.

### 2.3. Incomplete Course Assessment

The assessment methods used in machine learning courses typically rely on written exams and coursework reports, with limited emphasis placed on student skill in applying their knowledge [11]. Without sufficient guidance and feedback during coursework in phased learning, students often fail to achieve their full potential [4]. Furthermore, a lack of practical assessments in coursework makes it difficult for students to translate theoretical knowledge into practical skills, which hinders their

ability to master machine learning techniques and methods effectively. Moreover, the evaluation methods used in machine learning coursework can also suffer from issues of inaccuracy and unfairness. Traditional exams typically fail to demonstrate a student's proficiency in practical applications, making it challenging for them to prove their mastery effectively [12-14]. Additionally, it can be challenging for teachers to evaluate all individuals fairly and impartially.

In sum, machine learning course assessment methods display significant drawbacks, including their singularity, practical assessment inadequacies, equity, and quantitative value. Addressing these concerns will require the provision of greater practical opportunities for students and ample guidance and feedback, along with more diversified approaches to course evaluation, to better enhance student learning outcomes and application skills.

### 2.4. Insufficient Integration of Theory and Practice

Insufficient integration of theory and practice is a common issue in machine learning education. The primary reason for this disconnect is that the real-world application scenarios of machine learning are often intricate and demand students possess a solid theoretical foundation to comprehend and process [15]. However, current education systems prioritize theoretical knowledge over practical utilization, neglecting the importance of integration. Moreover, hands-on training required for machine learning coursework demands extensive resources and time, rendering students less likely to get sufficient practical exposure. This disconnect makes it challenging to generate a virtuous cycle of practical integration and theory, resulting in suboptimal teaching outcomes.

## 3. Teaching Reform Measures of Machine Learning Based on OBE Education Concept

The aim of reforming the machine learning course is to enable computer science students to develop both theoretical and practical skills. With this in mind, the following teaching objectives have been identified: to cultivate students' practical skills, to equip students with an independent understanding of managing machine learning problems, to enhance teamwork and innovative thinking, to provide a solid foundation for developing students' innovative ability, and to improve emotional intelligence and communication skills, which will raise students' interpersonal and professional competence.

The OBE philosophy emphasizes the development of student abilities and the cultivation of practical skills, providing powerful support in regards to reforming the machine learning curriculum.

### 3.1. Education that Focuses on the Fundamentals of Mathematics

As a field that relies on mathematical theory and algorithms, machine learning education demands a solid foundation in mathematics. As such, an essential strategy for reforming the machine learning course is to prioritize education that focuses on the fundamentals of mathematics, based on the OBE approach [16]. Teachers should concentrate on helping students master essential mathematical concepts, principles, and models, using concrete examples to teach mathematical knowledge. Mathematical formulas, models, and algorithms must be related to practical data analysis tasks, and practical exercises should be provided to enable students to deepen their understanding of the mathematical foundations of machine learning. The course should also prioritize cross-application between machine learning and mathematical knowledge, helping students develop a deeper understanding of algorithm principles and applications. Additionally, supplementing machine learning courses with additional online mathematical courses can help reinforce mathematical skills and improve students' overall learning experiences. In summary, to

address mathematical foundation concerns in machine learning education, it is essential to integrate mathematical knowledge into practical machine learning applications, teach specific cases and algorithms, and offer hands-on practical exercises to assist students in gaining a better grasp of the mathematical principles of machine learning.

### 3.2. Hybrid Instructional Design Based on OBE Orientation

Hybrid instructional design is a teaching method that combines traditional face-to-face teaching with online teaching. This approach helps to provide students with more opportunities to learn and fosters their learning and growth [17].

Implementing a hybrid instructional design based on OBE requires teachers to design and develop the online component of the course. Teachers can share teaching resources and provide recorded or live online classes through an online learning platform. Outside of class, students can freely access and study relevant materials, integrate and understand them, and master necessary skills and knowledge. Hybrid instructional design provides students with higher learning satisfaction, efficiency, autonomy, and better learning outcomes. By implementing hybrid instructional design, students can choose the learning method that best suits them, which enhances their ability to learn independently. This approach enables students to gain knowledge through other methods in addition to traditional face-to-face teaching, making their learning more active and targeted.

### 3.3. OBE-oriented Course Assessment Method

To address the problem of inadequate assessment methods in machine learning education, improving assessment methods can be a way to enhance student learning and motivation, thereby promoting the reform of machine learning courses. Firstly, a practice-oriented assessment method based on OBE can be used, such as providing students with relevant datasets, and allowing them to perform the whole process from data preprocessing, feature selection, model training, to model evaluation and algorithm analysis. This type of assessment not only tests students' practical and application skills but also enhances their learning interest and motivation. Secondly, various assessment methods can be used to promote student learning, such as combining classroom engagement, group cooperation, and homework exercises. These methods can effectively enhance students' learning and mastery of new knowledge. In addition, interesting case studies can be incorporated into the classroom to stimulate students' curiosity, creativity, and exploratory spirit. All these assessment methods can encourage students' innovation and independent thinking, enhance their professional and practical abilities, and improve their learning outcomes.

### 3.4. Combining Theory with Practice

Machine learning is a widely applied subject that requires both theoretical foundations and practical applications. However, the current issue in machine learning education is the lack of integration between theory and practice. To address this issue, OBE-based education should be combined with machine learning theory and practice. Reasonable teaching objectives, specific cases, and experiments should be designed to guide students in applying learned knowledge to solve practical problems. Teaching materials should be prepared in advance, and appropriate teaching cases should be selected to enable students to better understand related theories and apply them to practice effectively. Teachers should adopt outcome-based assessment methods to objectively evaluate students' learning outcomes. This enables the adjustment of teaching content and teaching methods and not only improves students' theoretical level but also trains their practical ability and

problem-solving skills, enabling them to better adapt to the application of machine learning in future work.

## 4. Conclusions

The OBE teaching philosophy has significant application value in the reform of machine learning courses. With the guidance of the OBE educational philosophy, the teaching effectiveness and sustainability of machine learning courses will be greatly improved. In the future, machine learning course reform will focus on exploring OBE-based educational philosophies, optimizing course content and teaching forms, and establishing multi-faceted evaluation mechanisms. These efforts aim to achieve the organic integration of education and practice, cultivate innovative and practical machine learning talents, and inject strong motivation into the development of future artificial intelligence.

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