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Exploration of Hybrid Teaching Mode of Machine Learning Course under the Background of Smart Education

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Abstract

Based on the needs of machine learning course teaching, and on the basis of breaking through the limitations of traditional teaching, this paper constructs a hybrid teaching mode of "intelligent diagnosis, dynamic adaptation and multi-dimensional interaction". With the help of learning analysis technology and intelligent algorithm, the teaching content is accurately layered, the learning path is personalized, and the teaching effect and students' classroom learning experience are improved by relying on online and offline multi-dimensional interaction scenarios. It is a reform idea and implementation framework of machine learning course teaching to integrate the new concept of education and teaching into it, which has very important practical significance.

Keywords

Smart education, machine learning courses, hybrid teaching model; teaching reform.

1. Introduction

Under the guidance of the development of digital economy and artificial intelligence, core technologies represented by machine learning are becoming the core driving force for industrial upgrading. Colleges and universities shoulder the function of professional talent input, and the quality of college curriculum teaching directly determines the effect of talent training. Smart education uses big data and other technologies to achieve all-round teaching perception, whole process recording and intelligent teaching decision-making, providing new ideas and methods for solving problems encountered in teaching [1]. Hybrid teaching is a modern teaching mode that organically combines online digital learning with traditional face-to-face classroom teaching. As a new teaching form with the deep integration of traditional classroom and online learning, it has the characteristics that teaching time and space can be extended, teaching resources can be integrated and teaching interaction can be deepened. Based on the above situation, studying how to construct the application of hybrid teaching mode in this context is to meet the needs of the development of the times, help to improve the teaching quality and cultivate more innovative talents.

2. Challenges in Teaching Machine Learning Courses

A questionnaire survey was carried out for students. A total of 100 questionnaires were distributed and 92 were effectively recovered, with an effective recovery rate of 92%. The questionnaire covers operation difficulty, teaching satisfaction, etc. Regularly carry out teaching seminars, jointly explore the current situation of learning, systematically analyze the common problems encountered in teaching, explore improvement methods, analyze teaching models, teaching methods, etc., and summarize the pain points and challenges in teaching.

The first is the contradiction between the teaching content and the students, that is, the teaching content is difficult to give consideration to the mathematical foundation, programming

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ability and learning interest of students at different levels, and it is difficult for students with weak mathematical foundation and insufficient learning motivation to deeply understand knowledge; For some students who have a good foundation, they think that the existing teaching model lacks flexibility and interest, and can not give full play to students' initiative and creativity, thus reducing teachers' enthusiasm for teaching.

Secondly, teaching practice and practical application are disconnected: at present, machine learning course practice mainly focuses on simplifying hypothetical scenarios, and can only learn step by step. When facing complex practical problems and real data, students' actual ability is easily ignored; In addition, due to the lack of advanced technologies such as in-depth learning, AutoML, and the introduction of real projects such as financial fraud detection, students cannot fully grasp the current popular industrial application scenarios and development directions.

3. Construction of Hybrid Teaching Mode"Intelligent Diagnosis, Dynamic Adaptation and Multi-dimensional Interaction"

3.1. Design of the Intelligent Diagnosis Mechanism

The intelligent diagnosis mechanism is one of the foundations of this hybrid teaching mode. Based on the learning analysis technology, it can collect and analyze the whole process of students' learning behavior, and then carry out targeted big data mining and processing for students' learning process to intelligently provide guidance for students. Data collection is mainly to collect structured data such as video playing, chapter tests, and homework completion of students in the rain class, and use natural language processing to obtain unstructured data such as content posted by students in the forum, questions sent to teachers, and records of group discussions, and analyze and understand semantics [2]. If the system finds that the student does not fully understand the knowledge related to matrix derivation in linear algebra, and the gradient calculation of logical regression involves matrix derivation, the system can diagnose the weak points of the student in mathematical foundation, and then provide accurate decision-making basis for subsequent teaching.

3.2. Dynamic Adaptation of Teaching Strategies

Analyze students' learning situation from the perspective of intelligent diagnosis, and push different teaching strategies according to the diagnosis results; The teaching content is divided into different levels, such as laying a solid foundation, improving ability, innovative development, etc; Give differentiated guidance to students and tailor their learning paths [3,4].

For students with weak foundation and insufficient programming experience, they should be provided with abundant learning resources and as many choices as possible. For example, when teaching the concept of back-propagation algorithm of neural network, in addition to the traditional way of deducing the formula with words, a 3D animation about the calculation process of this algorithm is made to help students intuitively understand the specific operation process of the algorithm and clearly grasp the flow path and parameter update mechanism of data in the network. In addition, we also provide a reference code implementation with line by line detailed explanation, which not only explains what to do at each step, but also explains why to do so to ensure that learners can fully understand the implementation process.

The ability promotion level is aimed at intermediate level students with certain basic and practical abilities, who are provided with algorithm optimization problems with certain difficulty or projects completed by team cooperation. For example, when optimizing the decision tree algorithm, teachers can point out that a single decision tree is prone to over fitting, weak anti noise ability, and insufficient model robustness when processing big data. Then let the students look up the data themselves, and think about whether the introduction of

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integrated learning algorithms such as random forest and gradient lifting tree into the decision tree will achieve good results. Among them, random forest can effectively reduce the risk of overfitting and improve the anti noise ability and robustness of the model by randomly sampling data and training multiple decision trees in parallel; The gradient lifting tree improves the expression of the model by training the decision tree in series and gradually correcting the error of the preorder tree. Both of them can achieve more accurate prediction by combining the results of multiple trees. Let students talk about their own plans in groups and make the final choice after full discussion [5]. Through such project practice, on the one hand, students can learn to comprehensively use the knowledge they have learned to solve practical problems; On the other hand, it can also train students' teamwork ability.

To further broaden perspectives and elevate research standards, an advanced research platform has been established for undergraduate students with strong academic potential and a keen interest in machine learning. Leveraging leading large-scale models such as the GPT series and Wenxin Yiyang, this platform encourages students in related fields to conduct innovative research on machine learning algorithms. For instance, exploring how to integrate the generative capabilities of large models with traditional supervised learning methods and applying these approaches to natural language processing and image generation provides significant insights into enhancing students' research skills and fostering a creative scientific mindset [6].

Furthermore, the learning pathway is not fixed; based on real-time assessment of student progress, high-performing students receive more advanced knowledge materials. If students still encounter difficulties with challenging content after a period of study, they can be provided with tailored foundational resources, along with personalized online support or in-person tutoring from instructors.

3.3. Construction of Multi-dimensional Interactive Scenarios

To foster students' deep learning and knowledge retention, we have developed a multidimensional interactive framework that integrates online and offline elements [7], embedding both approaches throughout the entire teaching process—from pre-class preparation to in-class instruction and post-class review, see Fig. 1.

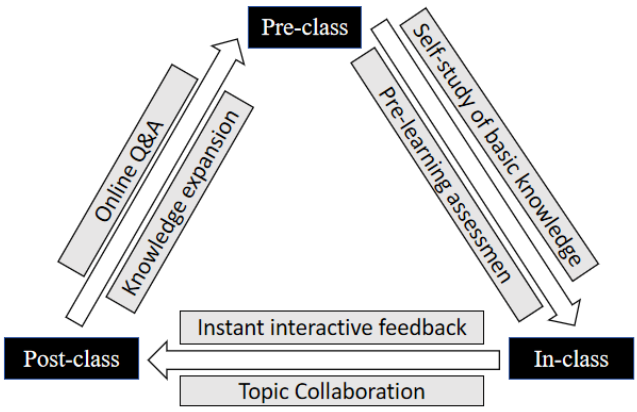

Figure 1. Structure for constructing multidimensional interactive scenarios

Online, an interactive environment combining "intelligent Q&A and discussion" is created. The "Study Companion" feature in Yuketang can accurately understand the meaning of students' questions and quickly retrieve answers from a vast knowledge database to provide responses. For example, when a student asks, "How can the overfitting problem in support vector machines be addressed?", the intelligent Q&A bot can list common solutions such as adjusting

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the penalty parameter C, using kernel functions, or increasing training data. Additionally, a "discussion forum" is established to encourage students to share learning insights and discuss technical challenges. Teachers regularly initiate discussion topics, such as "The application prospects of machine learning in medical image diagnosis," guiding students to participate actively and providing timely guidance and feedback during discussions to foster a positive learning atmosphere.

The offline classroom uses "project driven+group discussion" as the carrier to introduce real machine learning projects into the classroom. Teachers arrange projects with practical application value according to the course content and students' own situation, such as e-commerce commodity recommendation system (data based on user behavior), agricultural crop pest monitoring (based on satellite images), etc. Students complete the specific implementation of the project according to the division of labor in groups, including data collection, data cleaning, feature engineering, model selection training, result evaluation and optimization, and each step needs to be discussed and completed by the group members. In the process of group discussion, students can fully express their ideas and learn from each other. The teacher gives timely guidance and answers questions to the group students in the form of patrol, helps students solve problems, and further strengthens the interaction between teachers, students and students [8].

4. Implementation Pathways for the Hybrid Teaching Model

4.1. Development and Integration of Teaching Resources

The development and integration of teaching resources is an important guarantee for the smooth operation of hybrid teaching mode. The construction of hierarchical teaching resource database needs to be based on the principle of "teaching students in accordance with their aptitude and step by step", and make corresponding teaching resources according to different teaching purposes and different learning situations.

For the basic knowledge, experienced teachers will teach it in easy to understand language, supplemented by a large number of life examples and animation demonstrations, and disassemble the obscure concepts and principles. For example, when we talk about the clustering algorithm in machine learning, we divide all kinds of fruits into different categories as clustering examples, and show students how different clustering methods distinguish all kinds of fruits according to different characteristics such as color, size and shape through animation. The basic level exercises are based on the core knowledge points, with low difficulty, covering common basic question types: multiple-choice questions, blank filling questions and simple programming questions.

The resources of the capability improvement layer involve broader and deeper knowledge points, and will be combined with the learning tasks of corresponding professional knowledge, such as guiding students to use comprehensive algorithms to complete data analysis tasks, and putting forward more comprehensive and cross knowledge point knowledge application cases, such as establishing the risk assessment project of customer credit data by letting students use the previously learned knowledge such as decision tree and support vector machine, letting students choose their own algorithm to complete the model construction, and carrying out model performance evaluation and optimization according to the actual situation.

The resources of the innovation and expansion layer keep up with the forefront of the industry and continue to introduce the latest research into the classroom and practice; Broaden their horizons by guiding students to study excellent scientific research papers; At the same time, independent research topics and a high degree of freedom experimental platform are set up to provide students with more practical opportunities and stimulate innovation consciousness and practice spirit.

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In addition, make full use of the virtual simulation platform and open source data set to complete some related tasks: the virtual simulation platform can build a machine learning application environment close to the real scene, such as automatic driving target detection, intelligent traffic flow prediction, etc., which is convenient for students to learn relevant algorithms and programs. By obtaining MNIST handwritten digital data set, cifar-10 image data set and other open source data sets, students can easily obtain the data resources required for model training and algorithm verification.

4.2. Implementation Process of Hybrid Teaching Methods

The implementation process of hybrid teaching is shown in Fig. 2.

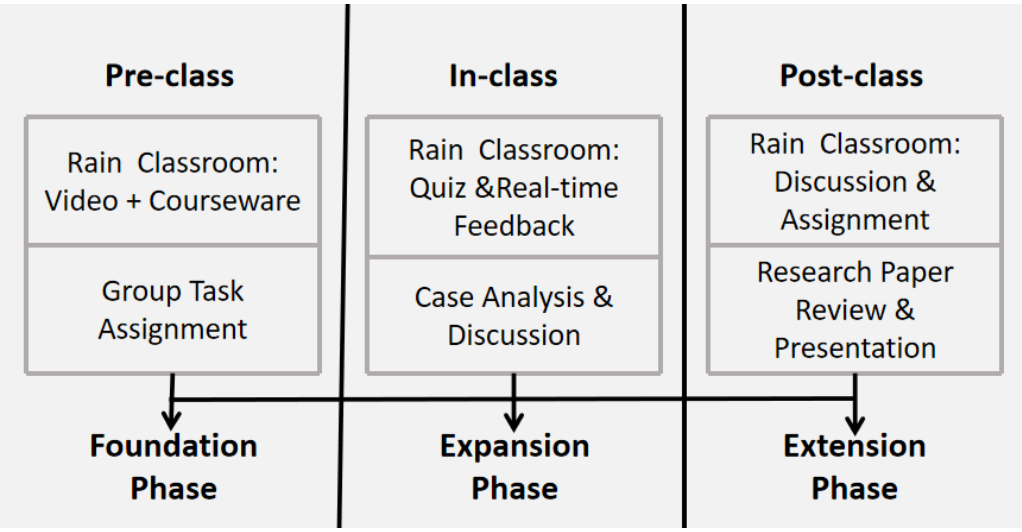

Figure 2. Implementation process of the hybrid teaching approach

4.2.1. Pre-class Stage

Before class, the teacher releases preview tasks in Rain Classroom, including teaching videos, preview documents, and problem-solving. Students arrange their own time for previewing and post their questions on the learning platform. The learning platform automatically collects students' questions and categorizes them to generate a learning situation analysis report for feedback to teachers. For example, before teaching the chapter on "Clustering", upload a teaching video about the basic concepts and application scenarios of clustering, and ask some questions that guide students to think, such as "Does clustering belong to supervised learning or unsupervised learning. After watching the video, students read the supporting documents and upload their own questions to the teaching platform on the premise of mastering the basic knowledge. With the help of the learning situation analysis report, it can be found that most students have difficulties in understanding the performance evaluation module of clustering. Teachers need to strengthen the teaching of this part in a targeted manner.

4.2.2. In-class Stage

IIn class, with the help of Rain Classroom answer barrage, real-time interactive feedback, and on-site discussions, teachers transform knowledge points into main problems or engineering cases, and organize groups to conduct in-depth analysis and debate. Teachers dynamically adjust the pace and depth of their explanations based on real-time answer accuracy, barrage keywords, and group reporting performance; At the same time, intelligent diagnostic models are used to process in class quizzes, group peer evaluations, and other data generated in real time, quickly generating "expansion point" achievement indicators - which not only test students' ability to apply and transfer theories, but also observe their teamwork and innovative thinking. This "teaching while evaluating, testing and diagnosing" model truly integrates

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process evaluation into the main teaching field, ensuring that the growth of each student's classroom participation ability is quantitatively tracked.

4.2.3. Post-class Stage

After class, students complete their assignments through Rain Classroom. After submitting their assignments, the system automatically corrects them and generates a report analyzing their mistakes, while clearly indicating the reasons for the errors and areas of knowledge weakness; Then the system will push personalized review materials to the student based on their mistakes, such as knowledge point explanation videos, similar practice questions, etc., to help them identify and fill in the gaps and consolidate their knowledge. Thus, a complete closed loop of "pre class consolidation, in class expansion, and post class extension" is formed, with process and diagnostic evaluation running through the entire process, truly realizing the systematic cultivation of new engineering talents' abilities through evaluation promoting learning and mathematics assisting teaching.

4.3. Reconstruction of the Teaching Evaluation System

Under the background of "New Engineering", the cultivation of students' abilities is a systematic development process, which not only tests their mastery of knowledge, but also their practical ability, and pays more attention to rigorous scientific attitude and innovative spirit. However, traditional assessment and evaluation models cannot effectively quantify the learning process, so it is necessary to construct a more scientific and reasonable assessment and evaluation system to strengthen process assessment. The allocation of assessment components is presented in Table 1.

Table 1. Distribution Table of Assessment Ratios

Evaluation Criteria	Content of Examination	Percentage (%)
Stage Testing	Mastering core theoretical knowledge at a specific stage, demonstrating the ability to derive algorithmic logic, and possessing comprehensive skills in applying knowledge points	8
school Assignment	Practical skills, hands-on abilities, and verbal communication skills	12
Project Implementation	Problem-solving skills, practical skills, writing skills, and teamwork skills	20
Final Assessment	Level of mastery of fundamental theoretical knowledge,and comprehensive ability in algorithm theory understanding, data processing and code implementation, as well as model evaluation and analysis	60

Specifically, efforts should be made to construct a "process based+diagnostic" teaching evaluation system, so that process based evaluation runs through the entire teaching process, focusing on students' participation and performance both online and offline (including online homework submission, homework quality, and group project contribution, etc.). At the same time, intelligent diagnostic models are used to regularly analyze the data generated from each assignment, exam, and project, dynamically understanding students' mastery of knowledge points and accurately identifying their strengths and weaknesses; After each chapter is completed, the system automatically generates diagnostic tests and generates reports based on the results, providing data support for teachers to adjust teaching strategies and helping students better carry out personalized learning. In short, the maturity and improvement of teaching models cannot be achieved without a scientific and reasonable curriculum assessment

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and evaluation mechanism as a solid support, in order to achieve comprehensive and objective evaluation of students.

5. Conclusion

The hybrid teaching mode of "intelligent diagnosis, dynamic adaptation and multi-dimensional interaction" is the actual process of applying intelligent technology to the teaching of machine learning course, and carries out a comprehensive analysis based on the construction of teaching mode and implementation path. This mode uses intelligent diagnosis to achieve accurate portrait, classifies and organizes teaching contents for different teaching objects and adapts them, and uses diversified interactive methods to promote students' in-depth learning. It is a breakthrough thinking for the current classroom teaching reform, and it is also a specific operable scheme. However, due to the limitations of technology and disciplines, this mode needs to be improved. It is necessary to strengthen the integration of mode and generative artificial intelligence and other technologies to form an intelligent immersive teaching situation; Strengthen the deep excavation and analysis of teaching data; Strengthen the cultivation of students' innovative ability and scientific research training; Optimizing teaching strategies; Highlight the comprehensive development requirements of morality, intelligence, physique, art and labor in the new era, adapt to the needs of talent training in the new era, and improve the teaching quality of professional courses in the school.

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