Framework of the Teaching Process Based on Machine Learning and Innovation Ability Cultivation in Big Data Background

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Abstract. Human beings have experienced agricultural, industrial and information society, followed by the era of artificial intelligence. The remarkable features of the era are big data and machine learning. It is an important task to cultivate high-tech innovative talents for colleges and universities in era of artificial intelligence background. So how to combine machine learning methods with training of innovation ability in the teaching process to improve the quality of talent training is a key problem in college teaching. To this end, a new teaching process framework based on machine learning and innovation ability cultivation is proposed, which lays a solid foundation for improving teaching quality.

Keywords: Big Data, Machine Learning, Teaching Process, Cultivation of Innovative Ability

1. Introduction
In the process of undergraduate teaching reform in colleges and universities, scholars at home and abroad have put forward different reform plans [1] from some aspects, such as the renewal of teaching content, the cultivation of students' practical ability, the management of examination process, the cultivation of college students' innovative spirit and innovative entrepreneurial practical ability and the construction of teaching management and quality assurance system. In recent years, the development and application of new technologies [2] such as big data, cloud computing and artificial intelligence have provided new ideas and paths for the reform of education and teaching in colleges and universities. In October 2016, the White House issued the "National artificial Intelligence R & D Strategic Plan ", which proposed that one of the core technologies of educating artificial intelligence is machine learning and deep learning, and its application and development should focus on data mining and learning analysis. On July 8,2017, the "New Generation artificial Intelligence Development Plan" issued by the State Council clearly pointed out that it is necessary to vigorously develop intelligent education and promote the innovative application of artificial intelligence technology in teaching. The application of machine learning in the field of education [3] has attracted the attention of domestic and foreign researchers. Machine learning is an important field of artificial intelligence and can be used to
interpret data and predict future data. Machine learning is mainly used in learning support, learning behavior modeling, predicting students’ risk of dropping out of school. The ecological model of artificial intelligence flipping classroom knowledge base can be constructed with the combination of artificial intelligence key technologies. Some foreign researchers have used decision tree, support vector machine, logical regression and other machine learning techniques [4] to analyze students’ learning data in depth and to predict the possibility of freshmen continuing to study in the next semester. At the same time, the clustering algorithm and association rules [5] are used to deeply mine the students’ learning data. Subsequently, we can recommend intelligently some courses to students.

In summary, the machine learning is mainly only used one aspect currently, such as the analysis and mining of teaching data, the prediction of behavior, the course recommendation and teaching evaluation. But there is short of literatures in view of the global reform plan for all the teaching and learning stages. To this end, we proposed a new research proposal for “whole teaching process”.

As a new teaching concept, whole teaching process covers many views including the formulation of students' training program, the renewal of teaching content, the reform of teaching methods, the management of examination process and the cultivation of college students' practical ability. The essential task of the whole teaching process is to enhance students’ information literacy and innovation ability. With the popularization of intelligent devices and the rapid development of information technology [6], the whole teaching process generates more and more data with the characteristics of volume, variety, velocity and value. Machine learning technology is more and more applied into various fields of human life and forming more and more mature artificial intelligence application achievement [7]. It is of great research significance for undergraduates teaching in colleges and universities to merge the conception of big data, machine learning and innovation cultivation into the whole teaching process and hence propose “the whole process of teaching based on machine learning and innovation ability cultivation under the background of big data”. Specifically, firstly, it can extend the machine learning method to teaching field, that is to say, artificial intelligence is applied into teaching field. Secondly, it can make best use of the mass data generated in the whole teaching process. Thirdly, it can improve the information literacy and innovation ability for college students and can fully supervise the students’ learning process.

2. Combination of Machine Learning Method and Innovative Ability Training in Teaching Process
The main research content of this paper is how to apply machine learning method into the whole teaching process, so as to improve students' information literacy and innovation ability, that is to say, the application of machine learning method in a series of teaching reforms. The relationship between machine learning methods and the whole teaching process reform is shown as figure 1.

![Fig. 1. Illustration of the relationship between machine learning methods and teaching reform](image)

The research of artificial intelligence in teaching reform is manifested in the following aspects

2.1. Teaching Environment and Teaching Resources
The change of resource environment is the foundation of teaching reform and the former leads to the latter [8]. Furthermore, the learning atmosphere is created to more satisfy the student requirements.
Subsequently, a good rotation is formed. The impact of technology on education and teaching is largely implemented through tools, media or environment. Firstly, the development of artificial intelligence breeds lots of new teaching and learning tools, such as intelligent teaching platform, teaching robot and intelligent learning software. These teaching and learning tools are good helpers for teachers and students and they can inject energy. Secondly, the development of artificial intelligence brings much convenience for learners to obtain resources. During the intelligent evolution, the machines cannot only assure the resource quality and label the semantics, but also classify the resources into forms as text and video. Hence, when the learning requirements are sensed by the intelligent environment, the intelligent environment can push suitable resources adaptively. Besides, the development of search engine can make learners find resources much more rapidly and save much more time. Finally, the developments of artificial intelligence provides convenience for constructing intelligent learning environment and propel digital education resources to intelligent learning environment.

2.2. Ways of Teaching and Learning
After artificial intelligence entering the education field, the change of technology support and environment leads a series of change among teaching and learning [9]. For teaching, artificial intelligence can do such work as following: aiding teacher preparation, generating individual teaching content, real-time monitoring of teaching process, achieving precision teaching, carrying out intelligent practical teaching based on technology and individualized question and answer, liberating teachers from simple and tedious affairs and truly returning to the work of "people ", reforming teaching methods and engaging in more creative labour. For teaching, with construction of the intelligent environment, it should focus much more on how to guide student. It should construct different kinds of tasks to create supporting learning environment.

2.3. Teaching Evaluation and Teaching Management
The development of technology and the optimization of teaching environment make the process data of teaching and learning more and more abundant [10]. How to fully and efficiently use these data to optimize teaching and learning needs educators to reform the traditional teaching evaluation and teaching management mode and method. In this paper, we apply artificial intelligence into education field. Firstly, we collect the teaching and learning data and then we use big data technology to mine these data, exam the teaching effect, diagnose the teaching problems, guide the teaching direction and improve the education management. By doing this, on one hand, it can help teaching managers to supervise in an all-round way, to transform the traditional experience-based management mode to intelligent and scientific mode and to improve management efficiency; on the other hand, it can establish digital portraits of learners, intelligently analyse and evaluate learners' behaviour, solve individualized education problems and scientifically assist teachers in teaching decisions.

3. The Research of Teaching Process
Based on the above analysis, the framework of the whole teaching process includes: network teaching process, online learning attention qualitative evaluation, achievement analysis and teaching evaluation. It is shown in figure 2.
Fig. 2. Chart of the research framework for the teaching process based on machine learning and innovation ability cultivation in big data background

3.1. Network Teaching Process
With the deepening of the concept of flipping classroom, modern network teaching plays a more and more important role in the field of education. But at present, the teaching environment and content are almost the same for different students in the traditional flipping classroom system. Students' personality characteristics cannot be used to improve their learning efficiency. In order to improve the teaching effect of flipping classroom and fully arouse the students' learning enthusiasm, we make best use of the advantages of easy understanding of the rules generated by decision tree and good interpretability of classification results and apply decision tree algorithm to the individualized decision analysis in flipping classroom. Therefore, an individualized flipping classroom teaching system based on decision tree is designed. In the flipping classroom teaching, there are three main factors that affect the students' online learning effect: online learning time, the number of exchange questions and the homework. The three factors are used as input data to develop the flipping classroom prototype system based on decision tree. The system predicts the students' learning effect at a certain stage through the generated decision tree. On one hand, the system can remind the students what should be paid attention to in the next study according to the different learning effect; On the other hand, the system can provide individualized reference for different students when assigning homework and organizing test paper.

3.2. Online Learning Attention Qualitative Evaluation
The machine learning algorithm is used to quantify the students’ visual attention and the obtained quantitation data is used to evaluate the online learning attention. The study mainly focuses on eye status classification. Specifically, firstly the eye features are extracted with Gabor/PCA (principal component analysis) and then semi-supervised or transfer learning is adopted to learn the final classifier. The degree of students’ visualization to screen (eyes opened or closed) is used as the measurement.

3.3. Achievement Analysis
The abilities of students are very uneven due to the expansion of college enrolment. The goal of each university is to make every efforts to improve students' academic performance. There are many factors that affect students' academic performance. The traditional analysis of students' academic achievement is only to get the mean/ variance/difference significance test/reliability/ validity and so on. And all these are considered from view of teaching and learning. In this paper, we apply decision tree method into achievements analysis. According to the response of decision tree, the corresponding measures are made to ensure that students can acquire knowledge more easily and happily. As a result, a solid
foundation is laid for improving the quality of education and teaching. Specifically, ID3 algorithm is adopted to classify the students’ achievement and then pruning algorithm is used to simplify the decision tree. Finally, the results are analysed to obtain the reasons affecting students’ achievement and other conclusions. Student database includes two parts: one is achievement and the other is survey information. The former includes homework and test score which generate from teaching process. The later includes the preference to major or course and using computer time which generate from questionnaire.

3.4. Teaching Evaluation
Teaching evaluation, as a former measure of teachers' teaching achievements, can promote teachers' rigorous teaching and hard work. However, the existing evaluation of teaching and learning system lacks for sound standard and approaches. On one hand, Research projects, funding, papers etc. have become a measurement for teachers’ performance which has contributed to the rapid success of the atmosphere. On the other hand, the existing evaluation measurement for teaching and learning depends on students' score or objective judgement from specialist, research group and student which can not reflect the teaching and learning level from comprehensive, systematic and scientific view. A better evaluation system for teaching and learning can not only help teachers to distinguish the disadvantage but also inspire teachers to make every efforts into work. To this end, we adopt gradient descent method to obtain a scientific model to evaluation of teaching and learning.

4. Conclusion
Through the seamless combination of machine learning method and the whole teaching process, the teaching and learning have been greatly improved and good results have been achieved. Specifically, 1) teaching from teachers’ view: renewing teachers’ knowledge structure, reforming teaching method, combining teaching with artificial intelligence; 2) learning from students’ view: improving students' learning motivation, improving classroom teaching atmosphere and the learning effect.

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