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# The Research on the Automatic Generation Method of Scaled and Personalized Training Model for Fundamental Disciplines

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***Abstract:*** *Given that the cultivation of talent in fundamental disciplines is a key strategy for educational and technological powerhouses worldwide, as well as China's high emphasis on it, this paper analyzes the factors that need to be considered in the cultivation of talent in fundamental disciplines and the existing issues in China's talent development in these fields. It conducts research on large-scale, personalized education methods to promote individualized learning. The rapid development of computer technology and artificial intelligence provides both theoretical and data-based foundations for advancing personalized education on a large scale, as well as the feasibility of background technologies for automatically generating objective and scientific personalized training models. Based on this, the paper proposes a method for automatically constructing large-scale personalized training models, including paths, content, and methods. It also analyzes the key technical issues to be addressed and presents practical approaches and potential for future automatic generation of training models.*

***Keywords:*** *Fundamental Disciplines; Personalized Training; Scaling; Automatic Generation; Machine Learning*

## 1. Question Proposal

The cultivation of talents in fundamental disciplines is one of the important strategies for educational and technological powers around the world, and it is also an urgent need for the teaching reform and development of higher education institutions. It serves as a driving force to improve the quality of talent cultivation[1]. In 2009, China launched the Everest Program, a joint initiative by the Ministry of Education, the Organization Department of the Communist Party of China, and the Ministry of Finance, to address the cultivation of outstanding students in fundamental disciplines[2]. This program focused on building training bases in five academic fields: mathematics, physics, biology, chemistry, and computer science[3]. In 2018, the Ministry of Education launched the "Top Talent Cultivation Plan 2.0 for Fundamental Disciplines," expanding the scope to include astronomy, geography, atmospheric science, oceanography, geophysics, geology, psychology, and basic medicine, in addition to the original five disciplines[4]. In 2020, the "Strong Foundation Program" was introduced to select and cultivate outstanding innovative talents in fundamental disciplines who are committed to serving the country's major strategic needs, emphasizing the supportive and leading role of fundamental disciplines. The 24th meeting of the Central Committee for Deepening Overall Reform in 2022 emphasized the need to plan comprehensively for the cultivation of talents in fundamental disciplines, scientifically determine the scale of talent cultivation, and passed the "Opinions on Strengthening the Cultivation of Talents in Fundamental Disciplines."In addition, General Secretary Xi Jinping mentioned in the September 2023 issue of Qiushi magazine that we must vigorously strengthen the development of fundamental disciplines, emerging disciplines, and interdisciplinary fields, focusing on the world's cutting-edge scientific advancements and the country's major strategic needs to promote scientific and technological innovation. This shows that the cultivation of talents in disciplines with scientific innovation has been elevated to a very high strategic level.

With the country implementing a series of talent cultivation plans and programs for fundamental disciplines, universities, as talent cultivation bases, have also responded to the call of these policies,

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boldly innovating in areas such as selection methods, cultivation goals, and training models. This has led to certain achievements in the cultivation of talent in fundamental disciplines[5]. For example, the Huqing College of Xi'an University of Architecture and Technology has driven innovation with scientific research, focusing on fundamental discipline competitions as the main tool, and striving to refine the characteristics of talent cultivation in independent colleges. By relying on the "University Chemistry Experiment" course, it has developed the "Internet + Four-dimensional Practice" teaching model, gradually exploring a talent cultivation model that starts with fundamental disciplines such as mathematics and chemistry, centers around scientific research innovation, and balances the enhancement of abilities and the solidification of results, in line with students' characteristics, national development requirements, and social talent demands[6].

Moreover, the majority of school training programs are tailored only for their own institutions, making it difficult to meet the needs of other schools, and they lack universality for external institutions[3]. Currently, teachers still rely on experiential teaching methods, and students continue to use traditional learning methods. Students receive the same curriculum, which may not be suitable for every individual. Teachers address the same issues for all students, but not all students necessarily need to resolve these problems. In this educational model, there is ineffective communication of academic information between teachers and students, leading to increased educational pressure and triggering educational anxiety.

Therefore, training programs that are designed solely for one institution are prone to creating "islands" of talent. Since other schools cannot adapt to these programs, the talent cultivated can only function within the original institution or specific fields, limiting the effective flow and sharing of talent. This not only restricts the development space of talent but also affects the optimal allocation of educational resources. Additionally, the training programs, being artificially created, are subjective, lacking scientific validity and sustainability.At the same time, the "Guiding Opinions on Promoting the Construction of New Educational Infrastructure and Building a High-Quality Educational Support System," issued in July 2021, proposed gathering various types of data to support educational and teaching reforms, emphasizing the need to promote the organic integration of large-scale education and personalized cultivation[7]. Therefore, it is urgent to address the challenge of personalized education at scale and promote individualized education through a data-driven model for cultivating foundational discipline talents[8]. The development of the internet and computer technology has provided platforms and possibilities for acquiring objective data. Meanwhile, the advancement of artificial intelligence and big data mining technologies has made it possible to analyze the inherent laws of situations from objective data, enabling the automatic generation of adaptive talent cultivation decision-making plans tailored to different schools and students.

## 2. Analysis of the Technological Foundation for Automatically Generating Training Models

Machine learning is the core of artificial intelligence technology, focusing on how computers can simulate or realize human learning behaviors. It involves acquiring new knowledge or skills to reorganize existing knowledge structures and continuously improve performance[9]. The promotion and application of artificial intelligence-related products is also an important manifestation of the development of machine learning. Its application in the education field has seen many attempts, driving personalized education from concept to practice, and achieving certain results[10]. For example, in educational scenarios, iFLYTEK's intelligent teaching, intelligent learning, and intelligent management systems have formed a series of typical and distinctive artificial intelligence educational application cases[11]. Its Knowledge Tracing (KT) model, utilizing intelligent tutoring systems (ITS), can provide a wealth of learning trajectory information to model students, automatically assess their knowledge levels, and offer personalized learning plans, thus achieving the goal of AI-assisted education. In addition, some organizations analyze the factors influencing learning methods and decision-making by collecting the decision paths of online learners' electronic resource selections, providing a basis for the development of personalized and precise online learning services[13].

In reinforcement learning, a type of machine learning algorithm, an agent takes actions in an environment and adjusts its strategy based on feedback to maximize cumulative rewards. The core idea is to learn how to make optimal decisions by continuously optimizing the behavior strategy through trial and error, aiming to maximize long-term cumulative rewards. Reinforcement learning has been widely applied in fields such as smart cities, recommendation systems, robotics control, energy optimization, gaming, and natural language processing, becoming one of the important branches of machine learning methods. Reinforcement learning can be used to create intelligent and comfortable learning environments

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in smart classrooms; it can analyze changes in student behavior, learning outcomes, and methods to improve overall learning efficiency; the intelligent learning classrooms created can realize the advantages of interactivity and flexibility in online learning[12].

In conclusion, the current technologies such as computer technology, artificial intelligence, and big data have made some progress in the field of education. Therefore, research on their application in the cultivation of talents in fundamental disciplines also has a certain theoretical and data foundation. It is feasible to automatically generate objective and scientific training models based on objective data and machine learning methods, considering factors such as individuals, resources, and the environment.

## 3. Pathways and Key Research Areas for Automatically Constructing Large-Scale Personalized Training Models

To promote personalized education on a large scale and address the challenges of individualized teaching for large groups, artificial intelligence algorithms and models can be used to provide a scientifically-based, data-driven, and personalized innovative training model for talents in fundamental disciplines. The research pathway mainly includes the following steps: First, study classification standards and training goals, and automatically categorize talent traits based on individual characteristics; second, study the automated design methods for teaching content and curriculum systems; third, research evaluation methods, using AI algorithms and models to adjust teaching content and curriculum systems, and provide customized training plans for talents.

### *3.1. Research Pathway*

The research path involving details is shown in Figure 1 as follows:① Acquisition of objective and effective information and data: Relevant data on talent characteristics, such as student traits, learning levels, etc., are obtained through student assessments, big data extraction, and other methods. This also includes data on teaching content and curriculum systems, such as existing training plans and feasible educational teaching methods.② Determining classification standards and student categorization: Machine learning algorithms, such as decision trees and support vector machines (SVM), are used to train and learn from large datasets, categorizing students based on their characteristics and goals. This data may include basic student information, learning history, interests, and hobbies.③ Data mining and determination of training models: Big data analytics techniques are used to mine past and present educational data to identify factors correlated with excellent learning outcomes, including course setup, teaching methods, teacher quality, etc[14]. By combining artificial intelligence algorithms (e.g., collaborative filtering, association rule mining), the data is analyzed to find the optimal teaching content and curriculum system.④ Determining evaluation methods and revising teaching content and curriculum systems: Artificial intelligence algorithms, such as reinforcement learning or neural networks, are used to establish an evaluation model. This model can automatically assess the effectiveness of the curriculum system, teaching content, and methods based on student learning performance, grades, and feedback. The model monitors and provides real-time feedback on various aspects of the teaching process, identifying and correcting potential issues in a timely manner. Through continuous feedback and revision, the teaching content and curriculum systems can better align with students' actual needs, achieving a customized training plan.

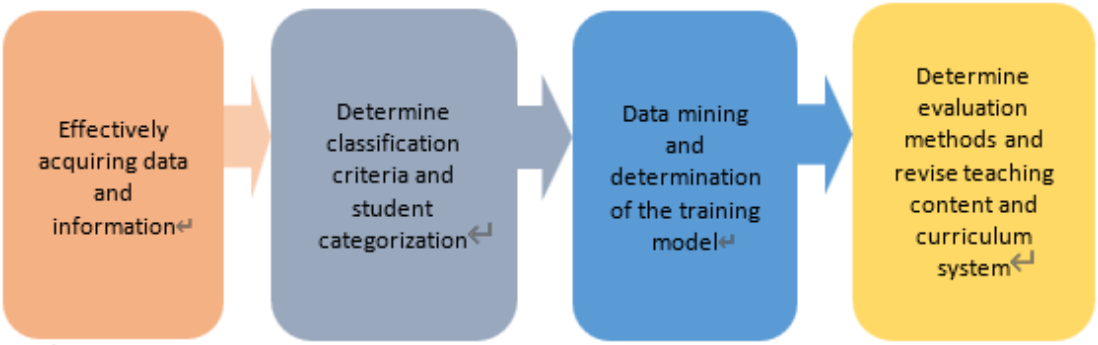


*Figure 1: Automatically Generated Training Model Roadmap*

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### *3.2. Key Research Topics In The Automatic Construction Of Training Models*

To automatically implement the content of Figure 1, the system for automatically generating training models fully utilizes the three key elements of machine learning (model, strategy, and algorithm). Among them, the model is the core of machine learning; it defines the relationship between inputs and outputs and determines the types of problems that machine learning can understand and solve. It can be applied in personalized learning recommendation systems, intelligent tutoring systems, and other areas. For example, by analyzing students' learning behaviors and performance data, a predictive model can be built to recommend suitable learning resources and methods, thus improving learning efficiency. The strategy refers to the goals and criteria during the model training process, which determine the objective function of machine learning and can be used for tasks such as learning path planning and course recommendations. By defining appropriate loss functions and regularization terms, learning paths can be optimized to ensure that students achieve the best learning outcomes within limited time. The algorithm refers to the specific steps used to solve the model parameters. It optimizes the model based on the given data and strategy and can be applied in automatic grading, intelligent scoring systems, and other areas. By applying efficient algorithms, students' learning achievements can be quickly and accurately evaluated, providing timely feedback. This involves the following two key research areas.

#### *3.2.1. Key Research Topic 1 - Intelligent Data Acquisition and Feature Processing*

By utilizing network technology, machine learning, and big data analysis techniques, a large amount of data and information related to the training programs of fundamental disciplines in universities can be quickly acquired and analyzed to complete the collection of raw data. However, among the features involved in the vast amount of data, some features contain rich information, some features have overlapping information, and some features are irrelevant, which can lead to the problem of dimensionality disaster and even reduce the accuracy of the model. Therefore, after data collection, feature engineering is performed, which involves transforming the raw data into training data for the model, extracting better feature data to ensure that the machine learning algorithm achieves optimal performance.

#### *3.2.2. Key Research Topic 2 - Construction of Adaptive Analysis and Decision-Making Model*

As shown in Figure 2, a reinforcement learning model based on the core Q-learning algorithm [15] is designed using the processed feature data. Data with good execution performance is rewarded, meaning that if the training and teaching model leads to progress in the development of fundamental discipline talent, it is given a positive score; otherwise, it is penalized. This method is used to predict the future and evaluate the effectiveness of these training models, determining the effectiveness of the corresponding model and execution, and inferring which training models should be implemented or modified next. It mainly utilizes the concept of Markov Decision Process (MDP) [16] in machine learning algorithms, where the current state of the system is determined based on the data (which can be understood as the student's current learning and development status). The next state in the Markov process is influenced not only by the current state but also by the action taken, which here refers to the execution of the corresponding teaching plan or training model, as shown in the ③-④ section of the research path in Figure 1. The goal of the Markov decision problem is to find an optimal strategy, which is a series of actions that maximize the evaluation function. This evaluation function can assess the quality of decisions, thus identifying and selecting the most suitable training model for the current student development stage from the data. In this process, indicators such as academic performance, overall literacy, and teaching quality assurance can be set as parameters of the evaluation function [17], guiding the model toward the desired research outcomes.

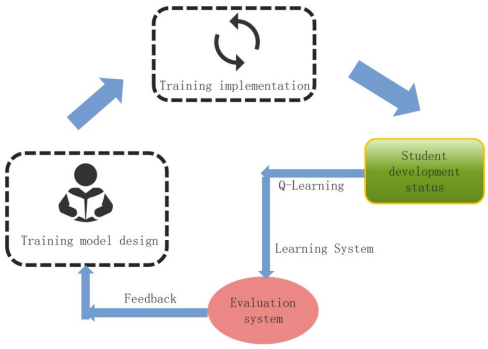


*Figure 2: The Mechanism of Automatic Generation of Training Models Based on Reinforcement Learning Method*

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## 4. Some Thoughts on the Automatic Generation Method of Training Models for Fundamental Discipline Talent

Given the subjectivity in training plans formulated by various universities, research on the automatic generation method of training models for fundamental discipline talent based on artificial intelligence and data-driven approaches is conducted to address the issues of scientificity and sustainability in current training programs. The main objectives involved are as follows:① Utilize big data mining technology to analyze and process the characteristics of different types of talent, achieve automated classification of talent types, and provide foundational data for formulating personalized training models.② Apply reinforcement learning-based intelligent decision-making models to calculate the most suitable adaptive and innovative training models for students, which align with the development of the times, through multiple iterations and future projections, and establish an objective and scientific evaluation system.

### *4.1. Research Pathway*

(1) Information technologies such as data mining and artificial intelligence models are used to extract the characteristics of excellent training models. The training models built based on these characteristics can be applied to student classification using artificial intelligence algorithms. According to the characteristics and assessment data of talents in different fundamental disciplines, the talents' personalities and traits are classified. The classification results can serve as important reference data for customizing training models.

(2) A model to ensure effective communication among talents with different knowledge structures. Based on data-driven artificial intelligence algorithms, the training model enables personalized education for talents with different characteristics while ensuring that the connection between talents is not fragmented, thus ensuring effective communication and interaction among talents with diverse knowledge structures.

(3) A reinforcement learning model for the automated generation of training models. The categorized student data and the constructed training models are input into the model for training. Through multiple iterations and future projections, the model calculates the most suitable innovative training model for students, aligned with the development of the times, and continuously improves the training model through the evaluation system.

(4) A scientifically refined evaluation system. Through interviews, big data surveys, and model analysis, the level of recognition from teachers and students regarding the training program is obtained, and a refined evaluation system is established through learning iterations in the reinforcement learning model.

### *4.2. Practical Methods and Potential of Automatically Generating Training Models in the Future*

Firstly, big data mining technology and natural language processing technology are applied to automatically collect digital information from students, teachers, schools, society, and the country, and then perform feature processing and analysis. Reinforcement learning, Markov processes, deep learning, and other machine learning methods are fully utilized to solve the optimal training plan by highly integrating these methods.

Secondly, based on traditional surveys and data analysis, an automatic computer intelligent training model analysis is constructed using machine learning and artificial intelligence algorithms such as reinforcement learning and deep learning. In the reinforcement learning model, the four elements (state, action, state transition probability, reward) are mapped to the corresponding student foundational subject learning and development training processes. This model is capable of constructing a feedback loop analysis and decision-making system, while providing objective evaluation outputs, and dynamically adjusting based on different environments and conditions.

Finally, breaking the traditional fixed methods for formulating basic subject talent cultivation models, the introduction of artificial intelligence models addresses the challenge of personalized education on a large scale and promotes individualized education. It provides customized, continually updated innovative training models for basic subject talents and creates personalized and precise training plans. That is, by classifying talents in different foundational subjects, big data and artificial intelligence algorithms are used to automatically generate scientifically grounded talent innovation cultivation models tailored to different schools, aligning with national and societal development needs. This model

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comprehensively plans talent cultivation programs, scientifically determines the talent cultivation model, and helps the country cultivate a large number of innovative and urgently needed foundational subject research talents.

## 5. Conclusions

This study explores the application of reinforcement learning and machine learning methods in the personalized training of basic disciplines. Through data acquisition, student classification, data mining, and the design of training models, the research found that it is possible to develop scientific classification standards and training strategies based on students' individual characteristics, thereby improving the quality of education. Data mining helps analyze students' needs and create personalized plans to optimize teaching effectiveness. Reinforcement learning adjusts training strategies through real-time feedback, enhancing the adaptability of teaching content. Combined with reinforcement neural networks, it further improves the intelligence of personalized teaching, achieving precise matching of learning needs and automated teaching optimization. In conclusion, this study provides theoretical support for optimizing personalized education models and promotes the intelligent development of education.

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