Journal of Combinatorial Mathematics and Combinatorial Computing
www.combinatorialpress.com/jcmcc

Combinatorial Press

Research on Dynamic Adjustment Model of Cultivation System of New Engineering Top Innovative Talents in Colleges and Universities Based on Intelligent Algorithm

Haili Yu[1,✉]

[1] *Mengxi Honors College, Jiangsu University, Zhenjiang, Jiangsu, 212013, China*

ABSTRACT

Local colleges and universities are an important part of China's higher education reform and development, and the quality of cultivation of top-notch innovative talents has a direct impact on the development speed and level of local economy. In this study, the decision tree algorithm is used to establish a prediction and early warning model for students' performance in the process of cultivating new engineering top-notch innovative talents in colleges and universities, and the K cross-validation method is used to optimize the model parameters and improve the prediction accuracy. Then, based on the intelligent prediction model and the cyclic structure intervention theory, we constructed a dynamic adjustment model for the cultivation system of new engineering top-notch innovative talents. The results of the empirical application of the model show that the hardware and facility conditions of talent cultivation in college D have significant improvement under the application of the dynamic adjustment model. In addition, both graduates (>4.00 points) and employers (>3.67 points) gave a high degree of achievement to the training quality of the university's top innovative talents in new engineering disciplines. This study helps to meet the demand for high-quality engineering talents for regional economic and social development, enhance the adaptability of higher education and improve the quality of talent cultivation.

Keywords: decision tree algorithm, parameter optimization, K cross-validation, talent cultivation, dynamic adjustment model

1. Introduction

The cultivation of top innovative talents in colleges and universities is one of the important tasks of modern higher education, and also an important force to promote social progress and economic development. Top innovative talents are innovative talents with persistent enterprising spirit, the habit of active independent learning and inquiry, strong analyzing and questioning ability, positive creative motivation and innovative habit [1-4]. The essence of cultivating top-notch innovative talents is to respect

✉ Corresponding author.
E-mail address: yuhaili@ujs.edu.cn (H. Yu).
Received 03 June 2024; Revised 11 September 2024; Accepted 19 November 2024; Published Online 15 April 2025.
DOI: 10.61091/jcmcc127a-073
© 2025 The Author(s). Published by Combinatorial Press. This is an open access article under the CC BY license (https://creativecommons.org/licenses/by/4.0/).

students' individuality and actively promote the full development of students' personality, and to explore students' potential and creativity in depth, in order to adapt to the needs of the national and social development of top-notch innovative and applied composite high-end talents in the new era and under the new situation [5-7].

The practice of cultivating top-notch innovative talents in colleges and universities needs to be scrutinized according to the requirements of the times and the needs of students, including the following aspects. First of all, we should give full play to the main role of students. Colleges and universities should vigorously implement the problem-oriented teaching mode, cultivate students' ability to solve practical problems, and improve students' independent learning and innovation ability. Secondly, we should emphasize the combination of practice and theory [8-10]. Colleges and universities should set up more practical courses to guide students to apply the theoretical knowledge they have learned to practice, deepen their understanding and mastery of knowledge, and cultivate their practical operation ability. In addition, research-oriented teaching should be strengthened. Colleges and universities should strengthen cooperation with enterprises and scientific research institutions to provide students with opportunities for scientific research practice and cultivate students' scientific research ability and innovative spirit [11-14]. Finally, it is necessary to create a favorable innovation atmosphere. Colleges and universities should actively promote the construction of innovation culture, encourage students' creative thinking and practice, create a good innovation atmosphere, and stimulate students' innovation potential [15].

Jun,Q. et al. applied the case study method to carry out research on cases in developed countries. Talent cultivation modes such as diversified learning and innovative learning were proposed based on the background of emerging engineering construction, aiming to meet the needs of Industry 4.0 talent cultivation and improve engineering practice ability [16]. Xiang-Shuo, H. based on the "dual-creation" perspective discusses the education and training programs and paths of excellent engineers in economic and management majors, and puts forward a talent cultivation model with reference significance for other colleges and universities based on the research object of a university [17]. Luo,J. et al. took Hunan University as an example and achieved good results in the implementation of IoT engineering by establishing an engineering practice teaching system for innovative talents, decomposing engineering practice ability into teaching tasks, and proposing a strategy for the cultivation of engineering practice ability in combination with the teaching conditions [18]. Lu, L. et al. summarized the current situation of innovation education for college students, and described the connotation of "science and education integration" and its role in the cultivation of college students' innovation ability. By proposing educational reform measures, they provide reference for the cultivation mode of high-quality innovative talents [19]. Liu,Q. et al. based on the characteristics of innovative talents, constructed an all-round cultivation mode of "3+0.5+0.5", aiming to ensure that on the basis of theoretical knowledge and basic skills teaching, to enhance the students' application knowledge and innovation ability, in order to cultivate innovative engineering management talents who are able to satisfy the market demand and have creative problem solving. Talents [20]. Huang,L. et al. not only discussed the connotation and necessity of the practical innovation ability of top talents and the important role of the theory of collaborative education on the cultivation of practical innovation ability, but also examined the mechanism of collaborative education of practical innovation ability in industry-specific colleges and universities. And they put forward the thinking of strengthening the cultivation of practical innovation ability of top talents in industry-specific colleges and universities [21]. Chen,T. analyzed the current situation and problems of innovative talents cultivation in China's higher engineering education, and constructed a "five-in-one" innovative talents cultivation model by using system theory. The internal factors of the classroom, practical teaching and other sub-systems and the coordinated operation mechanism between the systems were explored. The cultivation strategy of innovative talents is proposed [22].

In this paper, the information entropy as well as the information gain in the decision tree algorithm are calculated and defined, and the information gain rate is utilized as the segmentation parameter of the decision tree algorithm to grade the theoretical and practical achievements of the students in the process

of cultivation of new engineering top-notch innovative talents. Post-pruning processing of the decision tree is carried out by using the layer-by-layer pruning method from the leaf nodes, and the statistical way of statistical confidence interval is proposed to estimate the prediction bias of the decision tree algorithm. Then K-fold cross-validation method is used to optimize the parameters of the decision tree algorithm to realize the prediction and early warning of students' grades in the process of talent cultivation, which serves as an important basic algorithm in the dynamic adjustment model. Finally, under the guidance of cyclic structural intervention theory, this study is equipped with an intelligent prediction model to design a dynamic adjustment model for the cultivation system of top-notch innovative talents in new engineering disciplines. College D is selected as a pilot to implement the model, and the improvement of the talent training system construction after the model application is analyzed from the aspects of hardware facilities and enrollment quality in the talent training system of college D. At the same time, graduates and employers are evaluated. At the same time, the graduates and employers were surveyed on the quality of talent cultivation to explore the application effect of the dynamic adjustment model.

2. Construction of dynamic prediction model of talent training effect

2.1. *Information Entropy and Information Gain*

In this paper, the decision tree algorithm is used to construct a dynamic prediction model of the cultivation effect in the process of talent cultivation, and the data used in the model are the theoretical and practical scores of the relevant courses in the process of cultivating new engineering top-notch and innovative talents in colleges and universities. Numerical variables need to be discretized before the decision tree algorithm. As far as the decision tree theory is concerned, the core problem lies in how to define the split position of the best grouping variables, in the C5.0 algorithm is to use the index of information gain rate, which involves two of the concepts information entropy, information gain.

2.1.1. Information entropy. Information entropy [23] is a measure of average information. In sample set S, for an output variable with K categories, let the probability of taking the i rd category be $P(C,S)$. The information entropy $Ent(S)$ is defined as:

$$Ent(S) = -\sum_{i=1}^{k} P(C_i,S)\log_2\left(P(C_i,S)\right) \tag{1}$$

Assume that the value of information entropy is 0, which means that there is only a unique chance of the message being sent, i.e., $P(C_i,S)=1$, and there is no uncertainty about sending it. Assuming that the k signals from the source have the same chance of being sent, i.e., each of the $P(C_i,S)$ has $P(C_i,S)=1/k$, then the message is sent with the highest uncertainty and the information entropy reaches its peak. So $P(C_i,S)$ the smaller the difference, the greater the information entropy and the greater the average uncertainty. The greater the $P(C_i,S)$ difference, the lower the information entropy and the lower the average uncertainty.

2.1.2. Information gain. Information gain [24] expresses the ability of an information system to offset uncertainty. For input variable A (with grouped variables), given a group limit T, the data set S is partitioned into S_1 and S_2. So the information entropy $Ent(A,T;S)$ is defined as:

$$Ent(A,T;S) = \frac{|S_1|}{|S|}Ent(S_1) + \frac{|S_2|}{|S|}Ent(S_2) \tag{2}$$

In Eqs. $|S_1|$, $|S_2|$, and $|S|$ are the sample sizes of the sample sets S_1, S_2, and S.

Thus, the data gain $Gains(A,T;S)$ caused by the group limit T of the input variable A is defined as:

$$Gains(A,T;S) = Ent(S) - Ent(A,T;S) \tag{3}$$

$Ent(A,T)$ is the initial entropy and $Ent(A,T;S)$ is the posterior entropy.

2.1.3. Information gain rate. In the C5.0 algorithm, instead of using information gain directly, the information gain rate is used as a segmentation parameter [25]. The information gain rate is basically as:

$$\begin{aligned} GainsR(A,T;S_1) &= Gains(A,T;S_1)/Ent(S_1) \\ GainsR(A,T;S_2) &= Gains(A,T;S_2)/Ent(S_2) \end{aligned} \tag{4}$$

If $GainsR(A,T;S_1) > GainsR(A,T;S_2)$, select S_1 as the current best grouping variable.

Because the C5.0 algorithm uses MDLP (Minimum Representation Length Principle) binning algorithm to deal with the segmentation of numerical variables, and MDLP binning is bounded by the obtained group limit, and the data less than the group limit is divided into a group, and the data greater than the group limit is divided into another group, thus forming two forks, and its core measurement parameters are information entropy and signal gain. However, considering that the grading criteria of different teachers for course grades are different or the difficulty of the test papers is different, resulting in the general high or low course grades, it is not appropriate to directly use the MDLP binning method for discrete processing. Here, the ranking quantitative method is used to discretize the theoretical and practical performance data of students in the process of cultivating top-notch innovative talents in new engineering. The results of each subject are ranked first, with the top 10% being "excellent", the next 40% being "very good", the next 40% being "moderate" and the remaining 10% being "poor". In operation, each student's grade is taken as a random variable A, A obeys a normal distribution, i.e., $A \sim N(\overline{A}, d)$, $\overline{A}$ is the course mean, d is the course standard deviation, and the student's grade can be divided into the following according to the standard normal distribution table:

$$Excellent: A >= \overline{A} + 1.28 * d \tag{5}$$

$$Very\ good: \overline{A} <= A < \overline{A} + 1.28 * d \tag{6}$$

$$Medium: \overline{A} - 1.2 * d <= A < \overline{A} \tag{7}$$

$$Poor: A < \overline{A} - 1.28 * d \tag{8}$$

2.2. *Decision Tree Pruning Method*

The prediction target of this study is based on the schedule of teaching plan in the system of cultivating new engineering top-notch innovative talents in colleges and universities, which is mainly sorted out by the nature of the courses is the sequence of the opening of professional basic courses and professional courses. Then the theoretical grades and practical grades of the courses related to the training of talents opened earlier are selected as explanatory variables (i.e., input variables) to predict the course grades of the higher-order specialized courses related to them later as target variables (i.e., output variables), to find out the students who have big problems in terms of their grades, and intervene with them in advance in order to achieve the purpose of early warning.

After the decision tree has been grown, in order to prevent it from being overly “dependent” on the training samples, which may lead to the problem of over-modeling, the tree must be pruned, and the post-pruning method used in C5.0 is to prune the tree layer by layer from the leaf nodes, with the technical points being the estimation of the bias and the setting of pruning criteria.

2.2.1. Deviation estimation. C5.0 uses the statistics of statistical confidence intervals, which can be used to calculate bias on the training sample set. The basic idea is as follows.

1) For each node of the decision tree, the majority category of the output data is used to determine the range.

2) Let the i st node include N_i observations with E_i incorrectly judged detections, and the error rate,

i.e., the deviation, is $f_i = E_j / N_i$.

3) On the basis of the assumption of approximate normal distribution, make an interval calculation of the actual deviation e_i value for the i th node. The confidence level $1-a$ is given with:

$$P\left[\frac{f_i - e_i}{\sqrt{\frac{f_i(1-f_i)}{N_i}}} < \left| z_{\frac{\alpha}{2}} \right|\right] = 1-\alpha \tag{9}$$

In Eq. $Z_{\frac{\alpha}{2}}$ is the critical value. Thus, the upper confidence limit of the i nd node e_i , i.e., the pessimistic estimate is:

$$e_i = f_i + z\frac{a}{2}\sqrt{\frac{f_i(1-f_i)}{N_i}} \tag{10}$$

C5.0 defaults to a confidence level of 0.75 when α is 0.25, $Z_{\frac{\alpha}{2}} = 1.15$.

2.2.2. Pruning criteria. Based on the deviation estimation, C5.0 will determine whether to prune or not based on the "reduce by one deviation" method. First, the weighted deviation of all leaf nodes in the subtree to be pruned is estimated; then, the deviation of the parent nodes is compared, if it is greater than the deviation of the parent nodes, then they can be pruned, otherwise they cannot be pruned. The formula is:

$$\sum_{i=1}^{k} p_i e_i > e, i = 1, 2, \ldots, k \tag{11}$$

where k is the number of leaf nodes in the subtree to be cut, p_i is the sample size of the i rd leaf node as a percentage of the sample size of all subtrees, e_i is the statistical deviation of the i th leaf node, and e is the statistical deviation of the parent node.

2.3. Parameter optimization

The commonly used cross-validation method in C5.0 algorithm is K -fold cross-validation [26]. The K -fold cross-validation region is divided in the training set. Each time it is divided, it is trained, tested and evaluated in a different dataset and the evaluation result of the next one is obtained. The K -fold cross-validation process is shown below.

1) Unrepeated sampling divides the original data into k random part.

2) Each time, one of the copies is selected as a test set, and the remaining $k-1$ copies are used as a training set to train the model.

3) Repeat step (2) k times to obtain a model after training on one training set. Use this model to test, record and store the performance parameters of the module on the corresponding test set.

4) Calculate the mean of the results of the k sets of trials as a calculation of the model accuracy and as the main performance metric of the model under the current k -fold crossover trials.

Boosting algorithm is used as a method to improve the accuracy of the prediction results of the decision tree, the three elements of this algorithm are function model, objective function, and optimization algorithm.The function model of Boosting is superpositional. The objective function refers to the selection of some loss function for optimization. The optimization algorithm is greedy stepwise optimization.

3. Talent training system dynamic adjustment model

3.1. Cyclic Structure Intervention Theory

Based on the analysis of educational big data, the intervention engine is the core of the four-stage cyclic

structure intervention model of "state identification-strategy matching-intervention implementation-analysis of effectiveness", as shown in Figure 1. The model uses educational big data to identify and analyze the key features of the learner's learning state, filter and match the relevant intervention strategies from the intervention strategy library, implement and judge the effectiveness of the intervention strategies, and then identify the learner's new learning state. In terms of learner status identification, the model determines the learning status based on data from four aspects: the type of learning style, the level of learning progress, the level of learning interaction, and the level of academic achievement. By analyzing the data measured by the scale and synthesizing the learner's browsing record, learning path, learning content, interaction frequency and content, learning duration and academic achievement, the learning characteristics and learning needs of different learners are analyzed. Based on the analysis results, the teacher or system provides the matched learning intervention strategies to the learners. In this study, when constructing the dynamic adjustment model of the cultivation system of new engineering top-notch innovative talents in colleges and universities, we drew on the four-link cyclic structure of the model to form a data-driven dynamic adjustment model cyclic structure centered on intelligent analysis of data.

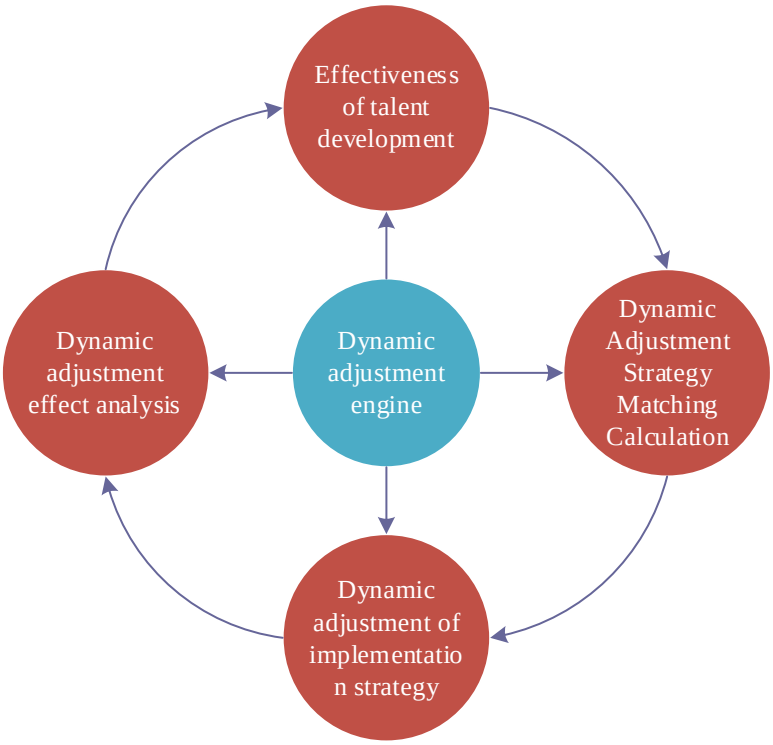

Fig. 1. Cyclic structure intervention model

3.2. Dynamic adjustment model design

The dynamic adjustment model of the new engineering top-notch innovative talents cultivation system designed based on intelligent algorithm and cyclic intervention theory is shown in Figure 2, which is divided into the planning stage, implementation stage, inspection stage and adjustment stage. Firstly, based on the actual demand of the new engineering top-notch innovative talents cultivation system, the talent cultivation objectives are determined.

1) Planning stage. On the basis of analyzing the professional talent training program, the talent training objectives are determined according to the students' characteristics. The course objectives are formulated in accordance with the program of "Talent Training Program→Analysis of Vocational Position Abilities→Analysis of Students' Characteristics", which mainly involves the objectives of professional knowledge, vocational ability and professionalism. Secondly, the teaching content is rationally arranged,

and the key points are directly hit. After determining the appropriate personnel training objectives, it is necessary to arrange the teaching content to ensure its correspondence with the course objectives. The design of teaching content should be close to the practical application and students' needs, arrange the course content in a targeted way, and focus on the design of teaching key and difficult points in order to improve the teaching effect. Finally, understanding the learning situation and characteristics of students is an important basis for the design of the program stage. Teachers can collect students' feedback and learning data through various forms of research and feedback in order to better personalize the design of the talent training system.

2) Implementation stage. The construction of the talent training system is carried out according to the requirements of the curriculum and hardware facilities of the talent training system in the planning stage.

3) Inspection stage. First, establish process evaluation. Process evaluation is mainly for the implementation of the talent training system, focusing on examining the effectiveness of the stage of the talent training process. Then according to the intelligent prediction and decision-making algorithm established above, real-time detection of deficiencies in the implementation of the talent training system.

4) Adjustment stage. Teachers in colleges and universities will summarize the teaching process of planning, implementation and testing in this stage to find out the deficiencies and problems in the talent training system. Finally, the talent training program will be adjusted to promote the development of students and improve the cultivation quality of new engineering top-notch innovative talents.

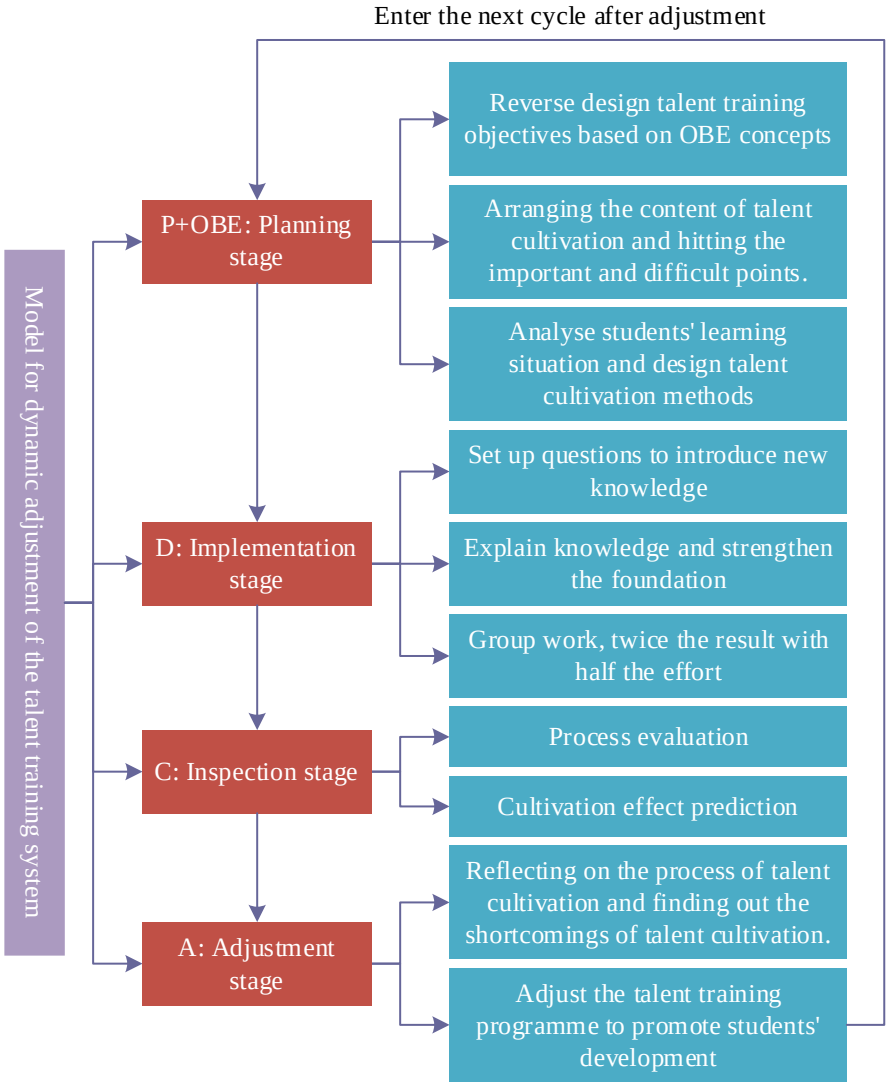

Fig. 2. Dynamic regulation model design

4. Effectiveness of the implementation of the dynamic adjustment model of the talent training system

4.1. Basic information on the subject universities

As a university with specialties in engineering, University D is one of the earliest universities with specialties in engineering established after the founding of New China. University D has always attached great importance to the professional construction work, with the goal of cultivating "new engineering top-notch innovative talents", in line with the purpose of serving the regional economic, social and industrial development, oriented by the social demand, based on Liaoning, relying on the industry, and highlighting the characteristics of engineering, constantly adjusting and optimizing the structure and layout of the profession, strengthening the connotation construction of the profession, focusing on the construction of Architecture, civil engineering, energy and power and other specialties, in the introduction of talent, faculty, school conditions to give key support, and constantly condense the professional schooling characteristics, forming a distinctive architectural characteristics, reasonable structure of the professional system, the college's existing engineering majors in the professional structure of more than 70%. At present, College D has three demonstration majors of first-class undergraduate education in S province, two pilot majors of innovation and entrepreneurship reform in S province, five advantageous and characteristic majors at the school level, eight characteristic majors at the school level, and three on-campus pilot majors of engineering education professional certification. The university drives the construction and development of other majors through the construction of advantageous and characteristic majors, and constantly improves the overall level of the construction of talent training system for engineering majors.

In conclusion, as an industry-specific institution, University D has always insisted on cultivating talents for the regional and national engineering industry since its foundation, and has always insisted on focusing on engineering majors in the process of running schools for more than 70 years, and the talents cultivated by University D have a considerable degree of competitiveness in the industry and have been recognized and praised by various employers. At the same time, the electrical energy program of University D has passed the professional accreditation of engineering education, and has made remarkable achievements in nurturing people under the perspective of professional accreditation, and its series of nurturing initiatives can undoubtedly provide good experience for reference. Therefore, University D is chosen as a test subject, on the basis of which a dynamic adjustment model of the cultivation system of top-notch innovative talents in new engineering disciplines in colleges and universities is piloted. On the basis of summarizing the implementation of the dynamic adjustment model in University D, it is typical, representative and feasible to explore the application effect of the dynamic adjustment model of the cultivation system of new engineering top-notch innovative talents in colleges and universities.

4.2. Analysis of the effect of improving the talent training system

4.2.1. Analysis of the construction of hardware facilities. The number of engineering majors has changed considerably from the founding of Collegiate D to 2020, showing an increasing trend from year to year. Between 2000 and 2010, the number of undergraduate majors increased from 5 to 16, rising to 21 in 2013, and as of 2020 there are 36 undergraduate majors. University D started to implement the dynamic adjustment model of the new engineering top-notch innovative talent cultivation system proposed in this paper in 2021, and continuously optimized the professional layout in the talent cultivation system of the university through the model's prediction and decision-making on the quality of talent cultivation within the university. It has formed a pattern of coordinated development of engineering, management, literature, arts and economics, and the scale of specialization has been expanding. Since the implementation of the dynamic adjustment model, the university has always adhered to the cultivation of top-notch innovative and high-quality talents in new engineering disciplines, and has made timely adjustments to the talent

cultivation system and facilities. It has added new majors that are urgently needed by the society, revamped traditional majors, and cultivated applied talents that are urgently needed by the society, making the coverage of disciplines wider and wider and the structure more and more reasonable. It has also constructed a perfect quality standard system for talent cultivation and a clear management process for talent cultivation system, which effectively enhances the social adaptability of talent cultivation and makes the quality of D colleges and universities continuously improve and realize leapfrog development.

The results of the analysis of the hardware conditions of the construction related to the cultivation of D talents in colleges and universities in 2023 are shown in Table 1, which shows that the hardware facilities required for the cultivation of various types of talents have been significantly improved. At present, the total area of colleges and universities reaches 652,400m², the property rights cover an area of 652,400m², and the total building area of schools is 496,200m². The existing teaching and administrative space (teaching, research and auxiliary space + administrative office space) of the college school totaled 182,451.62 m², of which the classroom area was 56,243.21 m² (including smart classroom area of 584.21 m²). At the end of 2023, the library had 1,326,400 paper books, with 12,546 new books added during the year, and 9.90 paper books per student. The college has built 4 practical training centers, 9 experimental centers and a total of 169 experimental and practical training rooms of various types. The school has also set up 25 applied research institutes, signed school-enterprise cooperation agreements with 231 enterprises and institutions, and added 8 provincial off-campus practice and education bases for college students. Relying on the school innovation platform and joint development with enterprises, the scientific research level of the school has been greatly improved. The setting and adjustment of specialties in the talent cultivation system has significantly improved the basic conditions in the cultivation system of new engineering top-notch innovative talents, optimized the allocation of teaching resources, and laid a solid foundation for the sustainable development of talent cultivation in colleges and universities.

Table 1. The basic school conditions index of university D

Basic facilities		School current value
School covers	Area (m^2)	652364.26
	Primary area (m^2 /student)	48.94
Administrative room for teaching	Area (m^2)	182451.62
	Primary area (m^2 /student)	13.48
Science and technology research instrument equipment	Raw value (10,000yuan)	1023.36
	New proportion (10,000yuan/student)	0.76
	New value (%)	12.45
Campus internship base	Area (m^2)	223641.26
	Primary area(m^2 /student)	16.69
Library	Total book	132645
	Raw books	9.90
Teaching calculator	Number of tables	2546
	Hundred students are equipped with several Numbers	19.00
Multimedia classroom	Seat number	32641
	Hundred students are equipped with several Numbers	243.61

4.2.2. Analysis of quantitative and qualitative changes in enrolment. The level of academic specialization is one of the main symbols to measure the level of talent training system in colleges and universities. The professional setting and adjustment of the cultivation system of new engineering top-notch innovative talents in colleges and universities should be combined with the market demand in order to better meet the needs of social development.D colleges and universities, as provincial private application-oriented colleges and universities, adhere to the "local, application-oriented" schooling orientation, and strive to fulfill the purpose of running schools to provide talents for the local economic and social development and

to achieve good results in practice. They have achieved good results in practice. Generally speaking, after the implementation of the dynamic adjustment model, the attractiveness of engineering majors in college D has increased year by year. The school's source of students is mainly in S province, enrolling for 25 provinces in China, and the enrollment covers a variety of program forms such as general undergraduate and master's degree, especially in S province, A province and other provinces (municipalities directly under the Central Government) above the local undergraduate and master's degree control line of the number of admission scores of the paragraph and the magnitude of a relatively large increase. The application rate of engineering majors in college D during 2020-2023 is analyzed as shown in Table 2. Since the implementation of the dynamic adjustment model of the cultivation system of new engineering top-notch innovative talents, college D has carried out a planned construction of the talent cultivation system, which makes the quality of engineering majors' student source show a good trend of steady increase. The new student enrollment rate increased on average from 92.48% in 2020 to about 99.29% in 2023, indicating that the number of new engineering innovative talents is increasing. In recent years, the university has proactively adapted to the needs of the urban and rural construction fields and the development of emerging industries, focused on the development of new engineering majors such as civil engineering and mechanical engineering, and focused on the construction of mechanical engineering and other majors for which students have a strong willingness to apply. These engineering majors first volunteer program to meet a high rate, the admission score is much higher than the average level of similar majors in the college, but also from the side of the response to the continuous improvement of the quality of this type of talent.

Table 2. 2020-2023 engineering professional registration situation

Professional name		Civil engineering	Mechanical design	Energy power	Architecture	Computer science
Planning number	2020	244	243	232	60	168
	2021	176	131	278	226	234
	2022	57	163	120	166	201
	2023	159	289	88	246	213
The first number of volunteers	2020	215	238	224	56	154
	2021	174	128	276	223	229
	2022	57	163	120	166	201
	2023	159	289	88	246	213
Actual number	2020	202	224	206	50	142
	2021	166	123	265	212	221
	2022	55	153	112	151	186
	2023	156	288	88	243	213
Reporting rate	2020	93.95%	93.98%	92.04%	90.04%	92.38%
	2021	95.67%	95.79%	96.09%	95.12%	96.42%
	2022	96.72%	93.71%	93.59%	90.77%	92.66%
	2023	98.34%	99.54%	99.9%	98.68%	99.99%

4.3. Analysis of the effectiveness of training innovative talents

4.3.1. Analysis of Graduate Satisfaction Levels. Satisfaction with professional learning is one of the important index points for measuring the quality of talent training system in colleges and universities. Specifically, the average score of fresh graduates in each measurement dimension can clearly reflect their satisfaction with the school's professional learning. This satisfaction survey was conducted on 1,128 fresh graduates of engineering majors in 2024 from University D in the dimensions of nurturing system (A1), curriculum system (A2), faculty (A3), hardware support conditions (A4), and teaching process (A5) of the cultivation system of top-notch and innovative talents in new engineering disciplines. The results of the

research data analysis of graduate satisfaction are shown in Figure 3. Fresh graduates in college D gave high ratings to the overall satisfaction of the talent training system constructed under the application of the dynamic adjustment model. The survey data showed that fresh graduates were most satisfied with the faculty and teaching process in the training system for top-notch innovative talents in the new engineering disciplines of the university, with 77.78% and 78.37% of the graduates indicating that they were very satisfied or satisfied, respectively. In addition, the survey results show that fresh graduates are also satisfied with the nurturing system, curriculum system and hardware support conditions implemented in the talent training system of our university.

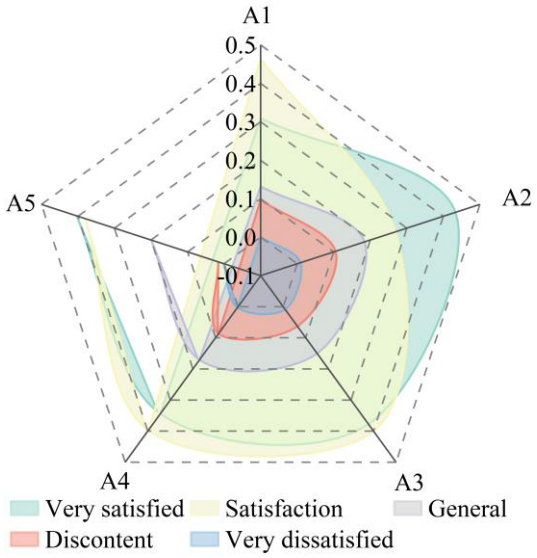

Fig. 3. Graduate satisfaction analysis results

4.3.2. Analysis of the fulfillment of graduation requirements:

1) Achievement of Graduation Requirements of Fresh Graduates. Under the perspective of talent cultivation, graduation requirements are a series of competence requirements that students obtain when they get the bachelor's degree after studying in colleges and universities, and the fulfillment of graduation requirements of fresh graduates directly reflects the quality of engineering education in the college or university as well as the quality of talent cultivation. Therefore, this paper analyzes the degree of achievement of graduation requirements of graduates in nine aspects, namely, mastery of engineering knowledge (B1), ability to use modern tools (B2), concept of engineering and society (B3), concept of environment and sustainable development (B4), professional norms (B5), individual and team (B6), communication (B7), innovation (B8), and lifelong learning (B9), respectively. Research on the 2023 fresh graduates of University D themselves and employers, the score range is 1-5 points (1 is the lowest score, 5 is the highest score), the results of the research results obtained from the analysis of the graduates of their own training requirements to achieve the results shown in Figure 4. From the dotted line in the figure you can see the average value of each dimension rating, overall, fresh graduates are given a high degree of achievement of their graduation requirements evaluation, the average value are higher than 4.00 points. The highest mean scores were given to professional norms (4.76) and lifelong learning (4.56), indicating that the graduates have developed a good sense of lifelong learning and are able to implement it seriously in their life and study.

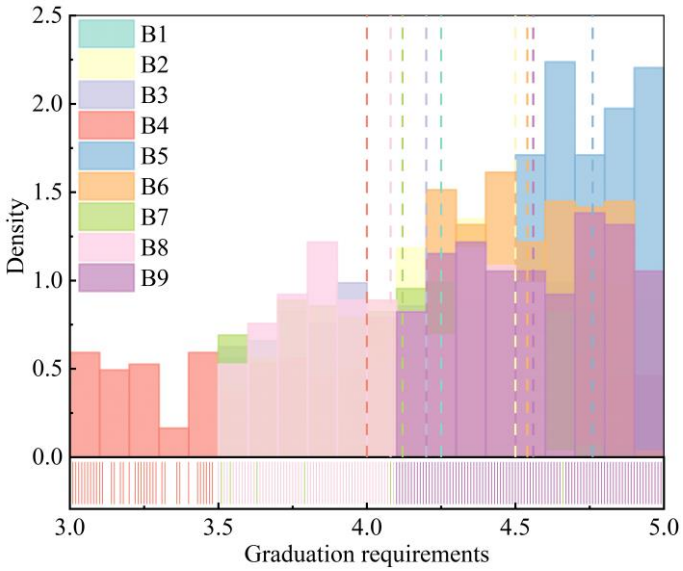

Fig. 4. The graduates' own cultivation achievement analysis results

2) Analysis of employers' assessment of graduates' graduation requirements. Employers' evaluation of graduates' graduation requirement fulfillment is also an important reflection of the quality of talent cultivation. In order to clarify the evaluation of employers' evaluation of graduates' graduation requirement fulfillment in University D, this paper conducted a systematic research on some (10) employers. In addition, in order to further verify the reality of employers' performance on the fulfillment of graduation requirements of fresh graduates of University D, this study also conducted semi-structured interviews with relevant responsible persons of some employers. The results of the analysis of the employers' evaluation of the university's talent training quality are shown in Table 3. On the whole, the survey results are basically consistent with the evaluation of fresh graduates on the achievement of their graduation requirements, and all of them have higher scores in the dimensions of ability to use modern tools (4.01 points), professional norms (4.02 points), individual and team dimensions (4.16 points) and lifelong learning (4.24 points) of new engineering top-notch innovative talents. This indicates that the construction of the university's talent training system has matured under the application of the dynamic adjustment model, and the model plays an important role in promoting the improvement of the quality of the cultivation of top-notch innovative talents in new engineering disciplines.

Table 3. The unit of the employing unit scores the results of graduation requirements

Dimension	B1	B2	B3	B4	B5	B6	B7	B8	B9
1	3.63	4.95	4.13	3.24	3.86	4.59	4.69	3.91	3.82
2	3.87	3.34	4.67	4.22	4.04	4.7	4.99	3.85	4.47
3	3.35	4.71	3.01	3.8	3.4	3.66	3.5	3.35	4.76
4	3.15	3.65	4.9	3.01	4.6	3.1	3	3.38	4.75
5	3.33	4.18	3.11	3.83	4.89	3.86	3.85	3.66	4.73
6	3.26	3.7	4.96	3.21	4.04	3.86	3.28	3.83	4.27
7	4.5	3.66	3.9	3.71	3.98	4.16	3	3.31	3.18
8	3.49	4.84	3.41	4.33	4.45	4.39	3.68	3.26	4.64
9	4.09	3.18	3.13	4.83	3.17	4.8	3.16	3.94	3.92
10	4.5	3.91	3.8	3.35	3.77	4.48	4.22	4.19	3.88
Average	3.72	4.01	3.90	3.75	4.02	4.16	3.74	3.67	4.24

5. Conclusion

Based on the decision tree algorithm, this paper proposes a prediction model of various kinds of student achievements in the cultivation of top-notch innovative talents in colleges and universities with new engineering disciplines, adjusts the cultivation strategy in a timely manner according to the early warning information of the model, and designs the dynamic adjustment model of the cultivation system of top-notch innovative talents in colleges and universities with new engineering disciplines, taking the cyclic structural intervention theory as the framework. The application effect of the model is studied in the university D characterized by engineering, and the results are found:

1) With the assistance of the dynamic adjustment model, College D has carried out detailed planning and construction of the talent cultivation system, and all kinds of hardware facilities required for talent cultivation have been significantly improved. The college has built four practical training centers, nine experimental centers, and a total of 169 experimental and practical training rooms of various types. It is also found that since the implementation of the dynamic adjustment model of the new engineering top-notch innovative talents cultivation system, the average enrollment rate of freshmen in the university's characteristic engineering majors has increased from 92.48% in 2020 to about 99.29% in 2023.

2) The research found that fresh graduates were most satisfied with the faculty and teaching process in the university's new engineering top-notch innovative talent cultivation system, with 77.78% and 78.37% of graduates indicating that they were very satisfied or satisfied, respectively. In addition, the graduates all gave a high degree of fulfillment evaluation of their graduation requirements, with the average value higher than 4.00. Employers also rated the individual and team dimension (4.16 points) and the lifelong learning dimension (4.24 points) of the university's training talents highly.

The dynamic adjustment model proposed in this study can meet the requirements for high-quality development of the cultivation of top-notch innovative talents in new engineering disciplines in colleges and universities, and contribute to the comprehensive development of talents in the field of engineering.

Funding

This work was supported by Jiangsu University Teaching Reform Research Project in 2023: Research and Practice of Training Mode of Top-notch Innovative Talents in Jiangsu University.

About the Author

Haili Yu was born in Nantong, Jiangsu. China, in 1986. She obtained a master's degree from Hohai University in China. She is currently working at Mengxi Honors College of Jiangsu University. Her main research direction is educational management.

References

[1] Zhao, Z., Wu, T., Ding, X., & Wang, A. (2017). Teaching strategies of innovative talents training in colleges and universities based on AHP. In 8th International Computer Systems and Education Management Conference (ICSEMC 2017) (pp. 208-211).

[2] Jing'ai, L., & Weiqing, L. (2019). Research on talent training model of new applied undergraduate colleges. International Journal of Information and Education Technology, 9(9), 652-660.

[3] Li, L. (2023). Research on training mode of innovative talents in universities under the background of digital economy. Frontiers in Educational Research, 6(16).

[4] Yan, Y. (2023). Model Construction and Path Optimization of Cultivating Top Innovative Talents in Universities. Frontiers in Educational Research, 6(19).

[5] Liu, F. (2020). Research on the Cultivation of International and Innovative Talents in Colleges and

Universities under the context of Belt and Road Initiative. Journal of Contemporary Educational Research, 4(2), 45-49.

[6] Liu, Y., Liu, X., & Liu, R. (2023). Research on the Training Path of Young Innovative Talents. Advances in Educational Technology and Psychology, 7(5), 1-7.

[7] Liao, S., Zhao, C., Chen, M., Yuan, J., & Zhou, P. (2022). Innovative strategies for talent cultivation in new ventures under higher education. Frontiers in psychology, 13, 843434.

[8] Guangshuai, G. (2024). The realistic dilemma and innovation path of training top innovative talents of graduate students. Adult and Higher Education, 6(6), 132-136.

[9] Yang, B. (2022). Research on Information Literacy Education in Colleges and Universities under the Mode of Innovative Talent Training. The Educational Review, USA, 6(11), 757-762.

[10] Kopzhassarova, U., Akbayeva, G., Eskazinova, Z., Belgibayeva, G., & Tazhikeyeva, A. (2016). Enhancement of Students' Independent Learning through Their Critical Thinking Skills Development. International Journal of Environmental and Science Education, 11(18), 11585-11592.

[11] POPESCU, E. F. (2021). Students' practical skills development in online education in COVID-19 context. Int. J. Educ. Res, 9, 21-34.

[12] Böttcher, F., & Thiel, F. (2018). Evaluating research-oriented teaching: a new instrument to assess university students' research competences. Higher Education, 75, 91-110.

[13] Shi, X., Xue, Z., & Zhang, H. (2015). A study on the research-oriented teaching courses reform in Chinese colleges and universities. International Journal of Information and Education Technology, 5(4), 260.

[14] Galeano, N., Morales-Menendez, R., & Cantú, F. J. (2012). Developing research skills in undergraduate students through an internship program in research and innovation. International Journal of Engineering Education, 28(1), 48.

[15] GANDEA, I. M. (2021). Learning methods and activities to stimulate creativity. Economic Convergence in European Union, 103.

[16] Jun, Q., & Jing, X. (2017, December). Innovation research on the emerging engineering talent cultivation mode in the era of industry 4.0. In 2017 International Conference on Industrial Informatics-Computing Technology, Intelligent Technology, Industrial Information Integration (ICIICII) (pp. 333-336). IEEE.

[17] Xiang-Shuo, H. (2022). Research on the Improvement of Innovative" Outstanding Engineer" Talent Cultivating. Journal of Applied Science and Engineering Innovation, 9(2), 102-105.

[18] Luo, J., Zheng, Y., Fu, B., & Luo, H. (2019, August). Cultivation of innovative talent engineering practice ability under the background of Emerging Engineering Education. In 2019 14th International Conference on Computer Science & Education (ICCSE) (pp. 720-724). IEEE.

[19] Lu, L., Yu, H., Tan, C., & Cui, B. (2024). Cultivation of Talents with Excellent Innovative Ability Based on the. Adult and Higher Education, 6(3), 79-84.

[20] Liu, Q., Zhou, Y., & Zhu, M. (2016, September). A Study on Building "3+ 0.5+ 0.5" Talent Cultivation Mode and the Nurturing of Creative Talents of Engineering Management. In International Conference on Construction and Real Estate Management 2016 (pp. 463-470). Reston, VA: American Society of Civil Engineers.

[21] Huang, L., Gu, C., Xu, X., & Ye, M. (2022, April). Exploration on the cultivation of practical innovation ability of top talents in industry-specific universities under the theory of collaborative education. In Proceedings of the 8th International Conference on Education and Training Technologies (pp. 98-103).

[22] Chen, T. (2018). Training Mode of Innovative Talents in Higher Engineering Education in China. Educational Sciences: Theory & Practice, 18(6).

[23] Qiong Liu,Mingjie Cai,Qingguo Li & Chaoqun Huang. (2025). Multi-label feature selection based on adaptive label enhancement and class-imbalance-aware fuzzy information entropy. International Journal of Approximate Reasoning109320-109320.

[24] Xinting Du & Hejin Wang. (2024). Efficient estimation of expected information gain in Bayesian experimental design with multi-index Monte Carlo. Statistics and Computing(6),200-200.

[25] H Y Taihuttu & I S Sitanggang. (2024). Spatial Classification of Forest and Land Fire Risk using Decision Tree C5.0 Algorithm. IOP Conference Series: Earth and Environmental Science(1).

[26] Serhat Ünalan,Osman Günay,Iskender Akkurt,Kadir Gunoglu & H.O. Tekin. (2024). A comparative study on breast cancer classification with stratified shuffle split and K-fold cross validation via ensembled machine learning. Journal of Radiation Research and Applied Sciences(4),101080-101080.