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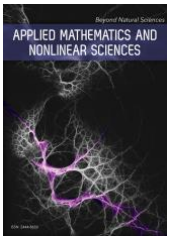

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Model Innovation Research of Cultivating Applied Art and Design Talents Based on Environmental Psychology

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Abstract

To achieve the training goal of applied innovative talents, this paper designs an innovative model of training applied art and design talents based on environmental psychology to improve the quality level and practical ability of art and design talents. The k-means algorithm is improved by introducing a particle swarm algorithm, using information entropy to verify the effect of the clustering. The improved algorithm is used in developing the talent training model to make the development results more reasonable. Based on the strength of the training performance of each classifier in the random forest, the individual classifiers are weighted to reduce the influence of the poorly performing classifiers on the talent training quality evaluation results. A multi-level fuzzy evaluation model is used to design a quality evaluation index system for applied talent training, which is used to measure the merits of the talent training model. To verify the feasibility of the designed model, the simulation analysis results show that the assessment achievement on course objectives 1-5 reached 0.6784, the average score on design content, methods and ideas was 4.34, and the comprehensive score of talent training quality evaluation was 85.64. It shows that environmental psychology can support the cultivation of applied art and design talents and promote the overall development of applied talents.

Keywords: Environmental psychology; K-means algorithm; Fuzzy evaluation model; Particle swarm algorithm.
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1 Introduction

With the development of the times, the status of applied talents in national construction is increasing. The training mode of applied talents is mainly centered on ability and is committed to cultivating technical application talents so that the cultivated talents can use the theoretical knowledge and methods they have mastered to solve practical problems [1-4]. However, in the actual cultivation process, the focus is usually on improving skill level. The lack of sufficient attention to cultivating psychological quality, innovation, entrepreneurship, and other abilities has resulted in many talented but not virtuous, conformist and non-applicable talents [5]. On the other hand, environmental psychology can guide students in the cultivation process so that students' inner cultivation can be effectively improved and strongly promote the construction of the applied art and design talent cultivation system [6].

Many experts and scholars have already adapted models of applied talent development in terms of disciplinary levels and educational disciplines. For example, the literature [7] developed a model for talent identification and development in physical education, identifying five main themes through interviews with a purposeful sample of 20 Spanish physical education teachers. Linking student thinking and physical abilities to identify and develop applied talents in physical education. The literature [8] describes and evaluates a talent development program for athletes in cricket, maintaining the link between individual, task and environmental factors by adopting a holistic approach to talent development. Semi-structured interviews were used to develop applied sports talent by obtaining information from the experiential knowledge of 16 elite female athletes and seven coaches. The literature [9] proposes an innovative pedagogical approach to talent development education that combines data visualization techniques and critical thinking training to improve students' decision-making literacy. A single-group pre-test and post-test designed curriculum experiment were conducted with 79 participants, and the results showed that this talent development approach improves global competencies in computational thinking and digital literacy. A global mobility talent development model was developed and tested in the literature [10]. The experiment collected data on 276 upward and downward relationships and analyzed them using structural equation modeling. The study results showed that promoting outplacement benefits mobility talent management development. The literature [11] proposed an incentive-based hospitality management talent selection program to create various talent selection and development models. A fuzzy comprehensive evaluation of the satisfaction level of the hotel management talent development process was conducted by establishing a hotel management talent gap measurement model. In summary, the training mode of applied talents is still in the exploration and practice stage, and from the form and content of the achieved results, they all focus on dovetailing with the latest development and needs of the industry and still lack active exploration in the reform of various aspects such as professional curriculum and teaching.

Based on the above, this paper first improves the k-means algorithm to make it possible to obtain the effective performance value of the applied art and design talent training model. Secondly, the random forest algorithm is used to measure the importance of talent cultivation features, and 73% of the features are selected for dimensionality reduction to improve the non-equilibrium phenomenon of the training samples and improve the accuracy of the talent cultivation quality evaluation results. Finally, using the quality evaluation index system of applied talent cultivation, the simulation results of the applied art talent cultivation model based on environmental psychology were analyzed, and its practical value in applied art design talent cultivation was proved from three aspects: course assessment, quantification of practical ability and talent cultivation quality evaluation data statistics.

2 Application-oriented talent training evaluation methods

2.1 Improved k-means clustering algorithm

The k-means clustering algorithm is a basic division method in clustering algorithms, which usually uses the error sum of squares criterion function as the clustering criterion function [12]. Its function is defined as:

$$J = \sum_{j=1}^{C} \sum_{k=1}^{n_j} \left\| x_k^{(j)} - m_j \right\|^2 \tag{1}$$

Where j=1,2,...,c; mj is the center of the c clusters, and its value is the mean of cluster ci, i.e.:

$$m_j = \frac{1}{n} \sum_{j=1}^{n_j} x_j \tag{2}$$

From the processing of the k-means clustering algorithm, it is easy to see that the selection of the initial class clustering center greatly impacts the clustering results, and different initial values lead to different results [13-15]. Even effective clustering results may not be obtained if the initial value is poorly chosen. Therefore, this paper makes some improvements to the k-means clustering algorithm by introducing the particle swarm algorithm to get a more effective k value and make the experimental results more reasonable.

2.1.1 Particle swarm algorithm

The proposed particle swarm algorithm originated from studying bird flock predation behavior. Its algorithmic idea is mainly reflected in changing the next step of population evolution using the individual and whole optimal values. In the basic particle swarm algorithm, there exists a swarm of particles in a D-dimensional space, the total number of particles is n, and each particle represents a solution in the set. The initial position and velocity of the randomly generated particle swarm are calculated iteratively until the optimal solution is found. The specific calculation formula is as follows:

$$\upsilon_{id}^{k+1} = \omega \upsilon_{id}^{k} + c_1 rand_1(\ ) \times \left(p_{id} - x_{id}^{k} \right) \tag{3}$$

$$x_{id}^{k+1} = x_{id}^{k} + \upsilon_{id}^{k+1} \tag{4}$$

The random function $rand_1(\ )$ will generate $[0,1]$ the random number, υ_{id}^{k} the velocity vector of the particle i flight after the k th iteration, ω the inertia weight function, c_1, c_2 the weight factor, p_{id} the individual best position of the particle i, p_{gd} the population best position, and x_{id}^{k} the particle i placement vector after the k th iteration.

2.1.2 Information entropy

Information entropy is used in information theory to measure the expected value of the occurrence of a random variable. In the information world, a high entropy value indicates that a large amount of information can be transmitted, and conversely, if the entropy value is low, it indicates that a small amount of information can be transmitted.

Let X be a discrete random variable with n possible values, respectively $\{x_1, x_2, \ldots, x_n\}$, and the probability of occurrence of each value is p_i. The corresponding probability distribution function is $P = (p_1, p_2, ..., p_n)$. The following expression defines the information entropy:

$$H(X) = H(p_1, p_2, ..., p_n) = -\sum_{i=1}^{n} p_i \log_2 p_i \tag{5}$$

Information entropy has two properties: all probability values are non-negative, which implies that all information entropy values are greater than or equal to zero. The information entropy takes the maximum value when and only when $p_1 = p_2 = ... = p_n$.

2.2 Analysis of Random Forest Algorithm

The essence of the random forest algorithm is a combinatorial classifier whose classification of the results of each sub-classifier jointly determines results. The flow of the random forest algorithm is shown in Figure 1.

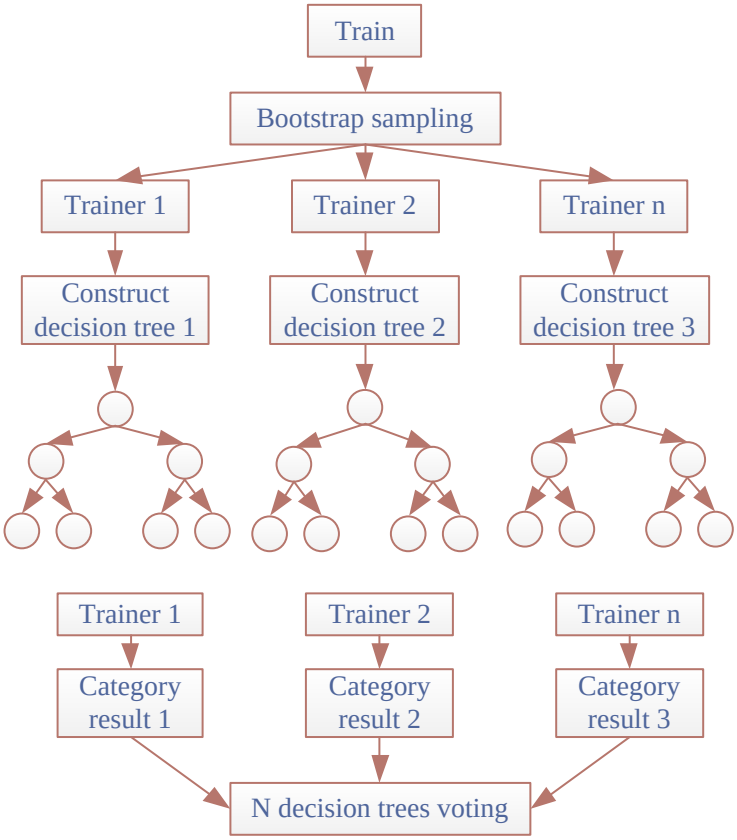


Figure 1. Random forest algorithm flow

Samples are drawn from the original training set D to form a sample set of applied art and design talent training, and some samples will not be drawn in the sample set. The probability that each sample in the training set is not drawn is:

$$p = (1 - 1/N)^N \tag{6}$$

When N tends to infinity, p is about 0.368, and it can be concluded that about 39% of the samples in the training set D will not be drawn. This part of the samples is out-of-bag and can be used for error estimation and feature importance analysis.

2.2.1 Feature Importance Measure

This paper uses the importance of each applied art and design talent training sample feature to select the sample features with higher importance to reduce the possibility of weak classifier generation. In this paper, the random forest ranking algorithm is chosen to calculate the feature importance, and the following are the main steps of the method:

Step 1: Select a sample feature X, introduce the noisy data randomly and calculate the out-of-bag sample again; the result is noted as $errOOB2$ the initial out-of-bag sample calculation result is noted as $errOOB1$. Suppose there are N decision trees in the random forest; then the importance of feature X is calculated by:

$$I_X = \frac{\sum_j^N \left(errOOB2_j - errOOB1_j \right)}{N} \tag{7}$$

Step 2: With the obtained ordered features, select 73% of the features and remove the next 20% of the features in the feature set.

Step 3: Repeat the above two steps until the number of features decreases to M. Finally, m final sets of features can be obtained.

2.2.2 F-measure weighting

In this paper, a novel base decision tree weighting method is designed based on the F-measure method, a common evaluation criterion in information retrieval and is often used to evaluate the goodness of classification models. Using the confusion matrix to calculate the recall and accuracy of the classifier, the recall is denoted as Recall, and the accuracy is denoted as ACC, then:

$$\mathrm{Re}\,call = \frac{TP}{TP + FN} \tag{8}$$

$$ACC = \frac{\left(TP + TN \right)}{TP + FP + FN + TN} \tag{9}$$

Among them, TP represents the prediction of high-quality applied art and design talents, accounting for the number of them. TN represents the prediction of low-quality applied art and design talents, accounting for the number of low-quality applied art and design talents. FP represents the probability of low-quality applied art and design talents being high-quality applied art and design talents, and FN represents the probability of high-quality applied art, and design talents for the probability of low-quality applied art and design talents.

According to the F-measure formula, the F-measure value of each decision tree forming the random forest classifier is calculated as:

$$F-measure=\frac{2\times recall\times precision}{recall+precision} \tag{10}$$

2.3 Multi-level fuzzy evaluation model

Setting up a set of factors for the training program of applied art and design talents:

$$U=\{U_1,U_2,U_3,U_4,U_5\} \tag{11}$$

If the fuzzy relationship on the i st factor is evaluated as v is $(r_{i1},r_{i2},r_{i3},r_{i4})$, then the evaluation matrix of the 5 factors is:

$$R=(r_{ij})_{5\times4} \tag{12}$$

Let the weight corresponding to the i st applied art, and design talents training be a_i, then the weight set is:

$$\sum_{1}^{n}a_i=1 \tag{13}$$

Its comprehensive evaluation results are:

$$B=A\otimes R=(b_1,b_2,\ldots b_m) \tag{14}$$

where $\otimes$ is an operator and $A=(a_1,a_2,\ldots,a_n)$.

Using the single-layer integrated evaluation model to obtain all the evaluation results of the layer i as b_{ij} the fuzzy matrix of its composition of the upper layer is as follows:

$$R_i=\begin{pmatrix}B_{i1}\\B_{i2}\\\vdots\\B_{il}\end{pmatrix}=\begin{pmatrix}b_{i11}&b_{i12}&\cdots&b_{i1m}\\b_{i21}&b_{i22}&\cdots&b_{i2m}\\\vdots&\vdots&\vdots&\vdots\\b_{il1}&b_{il2}&\cdots&b_{ilm}\end{pmatrix} \tag{15}$$

Where l is the number of applied art and design talents training objectives in the i th level. Let the weight set of the i nd level applied art and design talents training objectives be:

$$A_i=(a_{i1},a_{i2},\ldots a_{il}) \tag{16}$$

Then the comprehensive evaluation result of this layer is:

$$B_i=A_i\otimes R_i=(b_{i1},b_{i2},\ldots b_{im}) \tag{17}$$

From the lower level to the upper level for layer-by-layer evaluation, we can get the comprehensive evaluation result of the overall objective as:

$$a_{ij}=\sum_{k=1}^{m}(g_{ij}-r_{ijk})/\sum_{i=1}^{n}\sum_{k=1}^{m}(g_{ij}-r_{ijk}) \tag{18}$$

A multi-level fuzzy comprehensive evaluation index system is established using the set primary and secondary indicators, as shown in Table 1.

Table 1. Quality evaluation index system of the talent training program

	First-level Five-dimensional indicators	Secondary Indicators
Comprehensive Evaluation	Professional Competence Analysis Target System	Research Report
		Career positions
	Cultivation Specification Target System	Quality Objectives
		Competency Objectives
	Course Design Objective System	Course System Design
		Hours and Credits
	Guarantee Conditions Target System	Faculty
	Style and Basic Requirements	Body Requirements

As seen in Table 1, the evaluation index system references the theory of vocational education and fully analyzes various factors affecting the talent training program. The system selects an applied art, and the design talent cultivation program runs the model after quantifying the data according to the evaluation index system and performs quality calculations. And according to the running results, the score situation of each index item is judged to identify the cultivation of applied art and design talents.

3 Innovative model of talent cultivation based on environmental psychology

3.1 Reasonable classroom environment

In the traditional classroom, the single teaching method and the solidified teaching content will affect the mobilization of students' motivation, thus dulling the classroom atmosphere. The innovative mode of training applied art and design talents based on environmental psychology will limit the classroom size, especially when taking group classes, and will arrange the classroom size according to the area of the classroom environment. The density of the psychological environment is reduced by visual reduction, and the noise level is also effectively reduced. The innovative model of training applied art and design talents based on environmental psychology will also make reasonable planning for classroom interaction, not only by using more reasonable teacher-student interaction and student-student interaction but also by controlling some details in the interaction. For example, when teachers ask students questions, they should control the difficulty of the questions and focus on guidance in the questions so that students can get more solid knowledge in gradually solving problems. The arrangement of classroom space is well planned and can be arranged according to the characteristics of the teaching content.

3.2 Curriculum optimization

The innovative model of training applied art, and design talents based on environmental psychology uses an optimized curriculum to implement the goal of training applied talents. In the cultivation of thinking ability, the liberal arts curriculum is conducive to the development of the right brain, while the science curriculum is conducive to the development of the left brain, and only by promoting the interpenetration of the two can the thinking ability of learners be improved. In cultivating applied art and design talents, schools must offer corresponding science courses in their majors to promote the integration of humanistic and discursive thinking. The innovative model of cultivating applied art and

design talents based on environmental psychology will promote a reasonable set of basic and professional courses in the daily curriculum, thus laying the foundation for cultivating students' multiple intelligences.

3.3 Implementation of practical aspects

The practice link is significant in training applied art and design talents. The practice link of the innovative model of applied art design talent cultivation based on environmental psychology is shown in Figure 2.

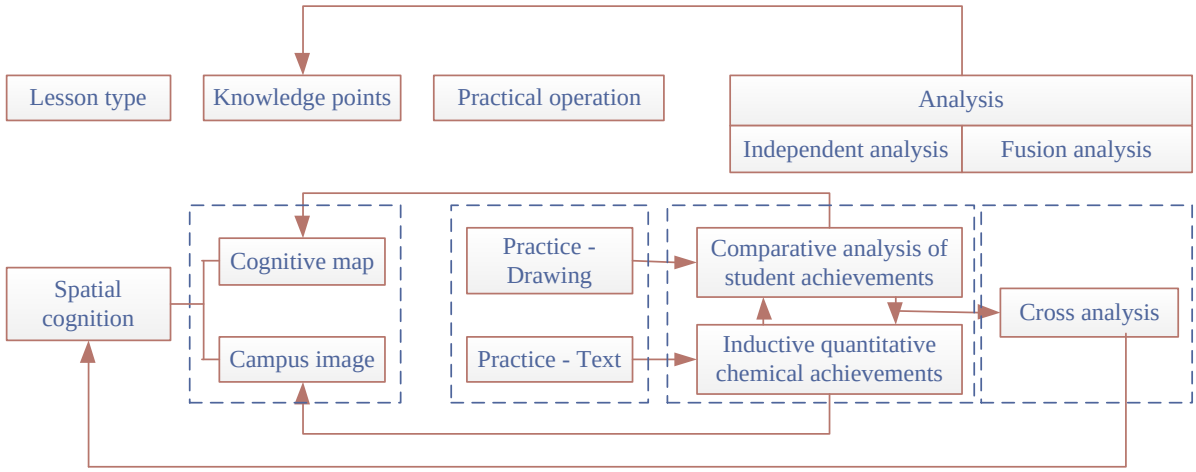


Figure 2. Design of practice within environmental psychology courses

As can be seen from Figure 2, the innovative model of training applied art and design talents based on environmental psychology discards the traditional model of simple lectures in the process of teaching and attaches importance to the design of students in the practical operation link, which is specifically designed as:

1) Increase the practical credits. Under the influence of the examination-based education system, many students have formed the idea of focusing on theory and neglecting practice and will unconsciously favor theoretical knowledge in the learning process, lacking sufficient attention to practice. As applied art and design talents, the cultivation of their practical ability is related to the industry's future development. Therefore, the innovative mode of training applied art design talents based on environmental psychology increases the practical courses in teaching and enhances the assessment ratio of practical courses to guide students to focus on practical ability cultivation.

2) Provide practice channels. Through practice guidance to enhance students' practical ability, for example, schools can adopt school-enterprise cooperation to let students participate in work sessions to establish the connection between theoretical knowledge and practice in the working process. In addition, the school can also hire excellent technical talents to provide practical guidance for students so that students' practical abilities can be effectively cultivated.

3.4 Innovative talent development model

The innovation model of applied art and design talent training based on environmental psychology focuses on innovation frontier guidance in the cultivation process to provide students with practical

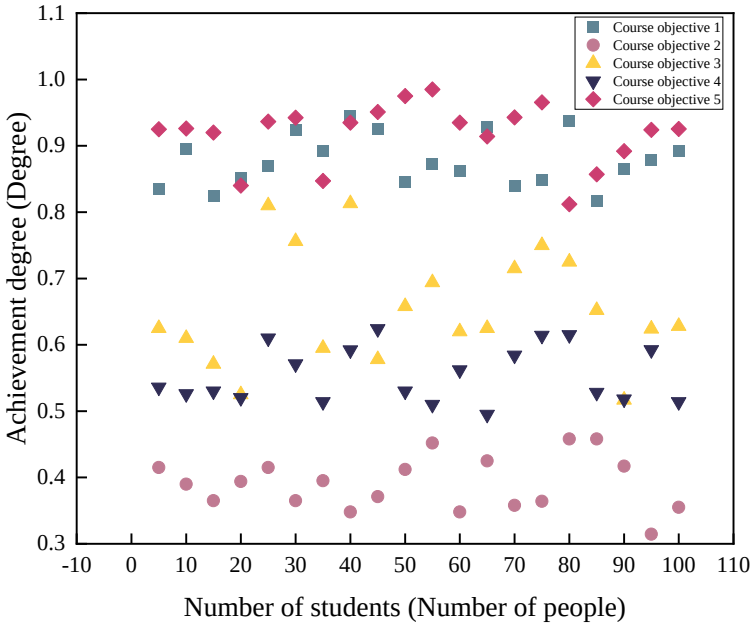
and effective innovation education to cultivate excellent innovation and entrepreneurial ability. Based on environmental psychology research, the innovation guidance process needs frontier knowledge and a good innovation atmosphere to mobilize students' willingness to innovate inherently. Thus, they can be more active in innovation education. Creating an innovation atmosphere in the innovation model of applied art and design talent training based on environmental psychology is mainly realized through campus culture construction. For example, innovation competitions are held to let students experience the fun of innovation in competitions. In addition, the innovation model of applied art and design talent cultivation based on environmental psychology also establishes an incentive mechanism to encourage students to actively innovate by setting innovation awards actively actively, thus making the innovation process go hand in hand with the pursuit of truth.

4 Simulation results analysis of the talent development model

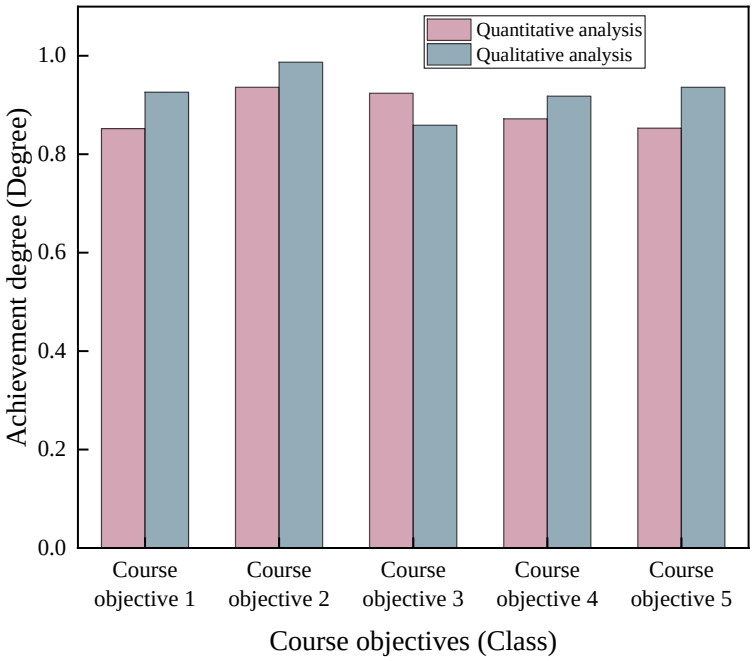
This paper designs an innovative model of applied art and design talent cultivation based on environmental psychology, combined with an improved k-means clustering algorithm and random forest algorithm to evaluate the talent cultivation model. To verify the applicability of the design model of this paper to the cultivation of applied art and design talents, the feasibility of the innovative model of cultivating applied art and design talents based on environmental psychology is analyzed through the statistical results of course assessment, quantification of practical ability and talent cultivation quality evaluation data.

4.1 Course assessment results

There are five-course objectives set out in the Art and Design course syllabus. Course objective 1 is to provide students with a comprehensive understanding of trends and disciplinary perspectives in the art and design industry. Course objective 2 is to master the basic content of art and design research and to use art and design methods for preliminary analysis and problem-solving. Course objective 3 enables students to apply various art and design theories and methods and conduct practical teaching and research activities. Course Objective 4 fosters cooperation and enables students to improve their humanities skills. Course Objective 5 is to bring into play the nurturing function of art and design and to combine practical teaching with character development. Course objectives 1 and 2 are assessed mainly by written examinations, which account for 60% of the assessment score. The assessment method of course objective 3 is based on the practice report, and the weight of the written examination aspect is 30%. Course objectives 4 and 5 are assessed mainly by the usual grades, and the written examination only accounts for 15% of the assessment grade. Based on the relationship between the above five course objectives and teaching arrangements, and considering the total number of hours of the course and other restrictions, the results of the achievement of the course assessment are summarized as shown in Figure 3.



(a) Individual differences in achievement of course assessment results



(b) Quantitative and qualitative course goal attainment

Figure 3. Assessment results of applied art and design talents training courses

From Figure 3(a), the assessment achievement of course objective 1 is 0.877, with the lowest value of 0.817 when the number of students is 80-85 and the highest value of 0.945 when the number of students reaches 35-40. The assessment achievement of course objective 2 is 0.39, with the lowest value of 0.3144 when the number of students is 90-95 and the highest value of 0.458 when the number of students reaches 75-85. The difference between the scores of students in course objectives 1-2 is insignificant, indicating that students have fully mastered the basic art design content and methods after using this design model. The assessment achievement of course objective 3 is 0.654, and that of course objective 4 is 0.554, indicating that the talent training model designed in this paper can

cultivate students' practical ability and cooperation spirit. The assessment achievement of course objective 5 is 0.917, which indicates that the talent cultivation model designed in this paper constitutes a multidimensional collaborative teaching space and has cultivated applied art and design talents with characteristics.

From Figure 3(b), the quantitative analysis value of course objective 2 is 0.946, and the qualitative analysis value is 0.987, the quantitative analysis value of course objective 4 is 0.872, and the qualitative analysis value is 0.918. The variance indicators of course objectives 2 and 4 are less than 0.05, and the differences in goal attainment are small and relatively concentrated. The quantitative analysis value of course objective 1 is 0.852, the qualitative analysis value is 0.926, and the variance indicator is 0.074. The quantitative analysis value of course objective 3 is 0.924, the qualitative analysis value is 0.859, and the variance indicator is 0.051. The quantitative analysis value of course objective 5 is 0.853, the qualitative analysis value is 0.936, and the variance indicator is 0.083. The degree of achievement of course objectives 1, 3, and 5 is relatively large, and there is a significant difference between quantitative and qualitative analysis. The degree of achievement of course objectives in quantitative analysis is lower than in qualitative analysis, especially in course objective 5. It indicates that the innovative model of training applied talents based on environmental psychology has significant advantages in nurturing function and forms a complete ecological chain of training applied artistic talents.

4.2 Quantitative results of practical ability

The key to the cultivation of applied talents is how students acquire knowledge, and improving students' practical ability is important to the cultivation of applied art and design talents. Therefore, this section analyzes the results of the innovative model of applied talent cultivation based on environmental psychology in terms of quantifying students' practical ability, and the results are shown in Figure 4.

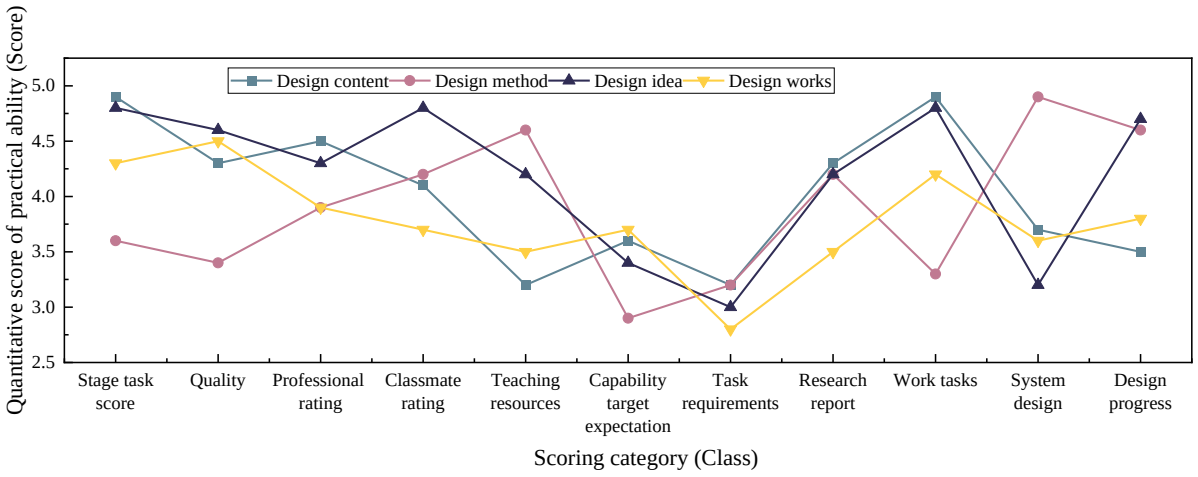


Figure 4. Quantitative results of application-oriented practice ability

As can be seen from Figure 4, the average score of the innovative model of training applied talents based on environmental psychology is 4.15 in design content, 4.6 in the design method, and 4.28 in design ideas. It shows that students have developed the habit of independent learning in the design process and can set their own design goals, determine the content and schedule of design, and choose the design method. The initiative has been effectively mobilized. And the students' practical ability was effectively reflected in their design works, with an overall effective score of 4.42 for the design works, indicating that the students could improve their course design practice based on executing the

course tasks. Thus, it can be seen that the innovative mode of training applied talents based on environmental psychology can strengthen students' sense of independent learning and cultivate applied art and design talents with core competitiveness.

4.3 Talent development quality evaluation data

In this section, 50 educational experts were invited to evaluate the quality of the innovative model of applied talent training based on environmental psychology, with the evaluation sets of excellent, good, qualified and unqualified. According to the quantitative data on the quality of the evaluation system, the quality diagnosis results of the talent training program of the design model in this paper are shown in Figure 5.

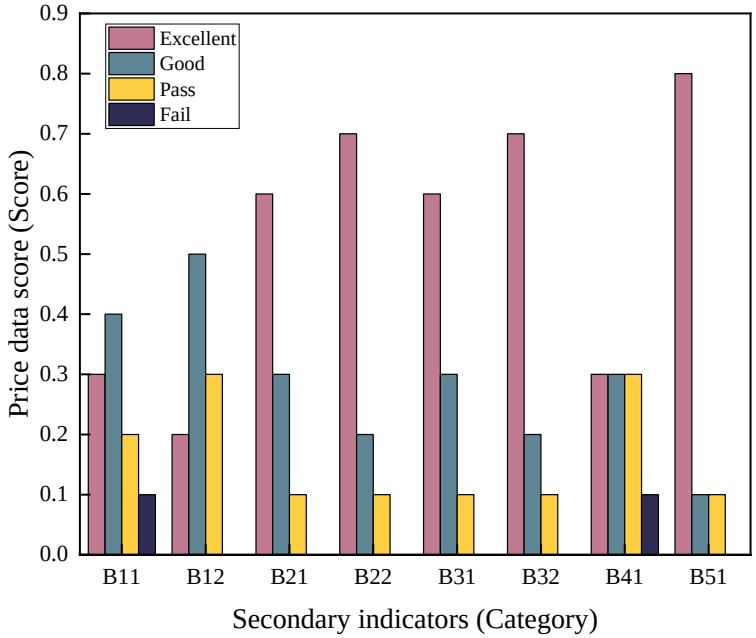


Figure 5. Quality evaluation statistics of the talent cultivation model

As can be seen from Figure 5, among the index scores, only the professional competence analysis target system and the guarantee condition target system have unqualified scores, and the proportion only accounts for 5%. The rest of the evaluation indexes all reach a good level and above. Among them, the rating level of the vocational ability analysis target system is good, which is decided by 45% of experts' ratings and 65% of experts' ratings of the training specification target system, curriculum design target system, and basic requirement system are excellent. Collating the evaluation data, it can be concluded that 47.5% of the experts considered the talent training model excellent, 35.6% considered the program good, 15.2% considered the program qualified, and 1.7% considered the program to be unqualified. A score of 85.64 was assigned to each evaluation level, indicating that this paper's design model is a relatively excellent talent training program. It can be seen that the design model of this paper is in line with the art design curriculum system of application ability cultivation and has the value of promotion for cultivating application-oriented art design talents.

5 Conclusion

Based on environmental psychology, this paper actively explores the cultivation model of applied art and design talents. An innovative model of applied talent cultivation based on environmental psychology is designed in the exploration process. And the feasibility of the model for the cultivation

of applied talents was verified by simulation analysis. The achievement of assessment on course objectives 1-5 reached 0.6784, indicating that the innovative model of applied talent cultivation based on environmental psychology strengthens the comprehensiveness of design within the course and is conducive to the cultivation of applied art and design talents. The average score on design content, methods and ideas is 4.34, reflected in the design works with 4.42 points. It shows that the design model in this paper can make the cultivation of applied art and design talents more scientific and reasonable, allowing students to get a full range of art and design education. On the evaluation of talent training quality, the comprehensive score is 85.64, which indicates that the design model of this paper is a relatively excellent talent training program with promotion value and practical significance.

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