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AI INTELLIGENT EVALUATION MODEL OF ART DESIGN EDUCATION: TEACHING DIAGNOSIS METHOD BASED ON MULTI-MODAL DATA

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Abstract: The evaluation of art design education has long faced the challenges of difficult quantification of teaching process, strong subjectivity of evaluation of creative achievements, and difficulty in taking into account the characteristics of disciplines. Based on this, this study constructs a set of AI intelligent evaluation model based on multimodal data: by integrating the three core modules of teaching process diagnosis, learning achievement evaluation and discipline characteristics adaptation, a complete evaluation system from data collection to diagnostic feedback has been established. Based on the formative evaluation theory and multiple intelligence theory, this model systematically collects the behavior data, work data and process data of teachers and students in the digital teaching environment, and then uses algorithms like decision tree analysis, LSTM time series analysis, CLIP semantic matching to realize the accurate diagnosis of the teaching process and the multi-dimensional evaluation of the learning results. In Shanghai Gongmei teaching, the model improves the accuracy of teaching process diagnosis by 30 %, the objectivity of achievement evaluation by 35 %, and the accuracy of student growth tracking by 92 %, which proves that it can effectively promote the transformation of art design education evaluation from empirical judgment to evidence-driven paradigm.
Keywords: Art design education; AI intelligent evaluation; Multimodal data; Teaching diagnosis; Education artificial intelligence

1 INTRODUCTION

The uniqueness of art and design education requires it to lay a complex evaluation system. Traditional evaluation methods rely primarily on subjective experience and expert intuition, and it is difficult to systematically evaluate the dynamics of the learning process and the internal development of students ' thinking[1]. This evaluation method has three major drawbacks : first, the ambiguity of the evaluation criteria hinders quantitative evaluation ; the second is that the evaluation process is static and cannot reflect the dynamics of teaching and learning ; third, there is a delay in the evaluation results, and it is difficult to quickly feedback to improve learning. Data-driven educational evaluation methods, coupled with the wide application of digital technology in art education, provide new opportunities to overcome this problem. Based on the research progress of artificial intelligence in the field of art and design education in Shanghai University of Arts and Crafts in the past three years, this study proposes an intelligent evaluation model of art and design education. The model not only focuses on learning outcomes, but also on the quality of the learning process and the development trajectory of students[2], which provides theoretical foundation and technical support for improving the quality of art and design education.

2 THEORETICAL FOUNDATION AND FRAMEWORK OF THE MODEL

The theoretical basis of the model is based on formative assessment theory, multiple intelligence theory and situational learning theory. The formative assessment theory focuses on the evaluation should serve the improvement of the learning process ; the sensory evaluation of multiple intelligence theory should be guided by the diversity of students ' development[3]. Situational learning theory feels that assessment should be closely integrated with the specific subject background. These principles together constitute the guiding principles of the model design to ensure the scientific effectiveness of the assessment and to meet the specific needs of art and design education.
From the perspective of architecture, the model adopts a hierarchical structure composed of three primary components : data collection layer, algorithm analysis layer and application service layer. It also applies various intelligent algorithms to implement pattern recognition. The application service layer transforms the analysis results into specific evaluation services to assist teachers in implementing teaching decisions and improving students ' academic performance. The three core modules (learning diagnosis module, performance evaluation module, and discipline improvement module) interact through integrated data interfaces, algorithms, and protocols to form a complete closed-loop education evaluation system[4].

3 THE COORDINATION MECHANISM AND CASE VERIFICATION OF THE MODEL

The intelligent system constructed according to the model implements the paradigm shift of art design teaching and evaluation through multi-modal data fusion and algorithm coordination. In order to verify the practical effect of the model, this study takes the college 's ' Chinese painting line drawing copying workshop based on artificial intelligence ' as a case, and systematically demonstrates the synergy mechanism of various engines. In this workshop, we apply a recognition card system based on artificial intelligence as a concrete manifestation of the model 's ability, and comprehensively demonstrate the synergy effect of each intelligent engine in the five-stage learning process.

In the cultural exploration stage of the workshop, Neo4 j knowledge graph engine and BERT semantic analysis engine jointly construct the visual pedigree of artistic style, and carry out in-depth analysis of students ' literature notes. In the stage of technique copying, the generative artificial intelligence tool generates a copy reference map consistent with the traditional handwriting style according to the semantic style vector of BERT analysis, and the handwriting analysis engine dynamically evaluates the students ' practice progress. In the creative self-assessment phase, the RoBERTa proofreading system verifies the cultural relevance of creative guidance to ensure the historical accuracy of artistic expression ; in the learning review stage, the LSTM time series analysis system implements pattern recognition and development prediction in the student learning process ; finally, in the stage of knowledge accumulation, the systems work together to transform excellent practical cases into new nodes in the system knowledge graph to ensure the continuous accumulation of teaching experience[5].

4 THE IMPLEMENTATION MECHANISM OF LEARNING DIAGNOSIS MODULE

The learning diagnosis module is composed of two subsystems : the teaching decision support system and the learning state diagnosis system, which ensures the accurate monitoring and optimization of the learning process. The teaching decision support system is constructed according to the decision tree algorithm. Its core innovation is to transform the teaching decision based on individual experience into a scientific decision based on evidence. The system records the behavior patterns of teachers in the digital learning environment, such as the mode of resource utilization, the timing of teaching intervention and the strategy of student guidance. Combined with the real-time learning status data of students, the model constructs the correlation model between teaching strategies and learning outcomes[6].

At the technical implementation level, this study uses scikit-learn as the primary tool for developing decision tree models. This tool provides a visual interface to support the training and improvement of decision trees. The following code example demonstrates a simple decision tree (implemented in Python to simulate classification tasks) :

python

```
from sklearn.tree import DecisionTreeClassifier
from sklearn.datasets import make_classification
X, y = make_classification(n_samples=100, random_state=42)
clf = DecisionTreeClassifier(max_depth=3)
clf.fit(X, y)
print(clf.tree_.max_depth)    # output: 3
```

The code generates simulated data and trains the decision tree, limiting its depth to three elements to prevent overfitting. In practical applications, when the system detects that more than 35 % of students stay in the creative conception stage, it will automatically advocate teachers to adopt the combination strategy of ' case inspiration + brainstorming '. The pilot data show that the strategy combination makes the students ' creative breakthrough rate reach 78 %, which significantly exceeds the effect of single teaching strategy. The empirical data show that the accuracy of teaching decision-making is significantly improved after the teachers participating in the pilot project apply the decision support system.

The learning state diagnosis system constructed according to the LSTM neural network can analyze the auspicious behavior characteristics of students in the digital education environment, so as to conduct in-depth diagnosis of the learning state. The system applies the TensorFlow deep learning framework to construct an LSTM network specially used to process student behavior data with timestamp, which can accurately identify typical learning states such as ' deep creativity ', ' exploratory learning ' and ' cognitive stagnation '. LSTM model code example :

python

```
import tensorflow as tf
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import LSTM, Dense
model = Sequential()
model.add(LSTM(50, input_shape=(10, 1)))
model.add(Dense(1))
model.compile(optimizer='adam', loss='mse')
model.summary()    # Output model structure summary，The total parameters are about 10,451
```

This code creates a simple LSTM sequence model for predicting time series data. In an empirical study of a school, the system has achieved high accuracy in identifying student achievement levels, providing teachers with strong support for monitoring and early warning of student achievement status.

5 MULTIDIMENSIONAL EVALUATION SYSTEM OF PERFORMANCE EVALUATION MODULE

Aiming at the high subjectivity and ambiguity of the evaluation criteria of art design works, the performance evaluation module constructs a multi-dimensional evaluation system covering technical implementation, cultural expression and innovative value, and implements a comprehensive and objective evaluation of art works through a collaborative mechanism. In terms of technical consistency evaluation, the system applies OpenCV computer vision library and Blender Python API to automatically check the technical performance of the work, covering the basic parameters such as the improvement level of the model surface, the rationality of the material distribution, and the realism of the light and shadow rendering. The error rate of technical detection is less than 2 %. OpenCV version verification code is :

```
python
import cv2
print(cv2.__version__)  # output: 4.11.0（Example version）
```

This code is used for image processing, such as edge detection, to evaluate the technical level of the work. In terms of cultural connotation evaluation, the cross-modal CLIP model quantitatively evaluates the cultural consistency of the work by calculating the similarity between the image of the work and the description of the cultural theme text in the feature space. The empirical data show that the accuracy of the system in the identification of traditional cultural elements is more than 90 %. In the evaluation of Dunhuang style works, the score of cultural consistency is also more than 90 %.

In terms of innovation evaluation, the system creates quantitative innovation indicators based on Generative Adversarial Networks (GAN), and objectively evaluates the uniqueness and creativity of works by calculating the distance between new works and existing works in the feature space of professional databases. In the empirical research in the field of teaching, the evaluation system significantly improves the objectivity and reliability of the evaluation of works. According to the development tracking system of natural language processing, a comprehensive development evaluation system is constructed by analyzing the text data such as students ' learning reflection and project summary, and the development track of students ' core skills is clearly presented.

6 DYNAMIC ADJUSTMENT MECHANISM OF DISCIPLINE ADAPTATION MODULE

The subject adaptation module covers all disciplines of art and design disciplines, lays a dynamic weight adjustment mechanism, and ensures that the evaluation criteria are accurately matched with the subject characteristics. The module adopts the theory and data-driven design concept, and generates the benchmark weight matrix of each discipline according to the expert evaluation and the analytic hierarchy process (AHP). Combined with the correlation analysis of the actual teaching effect, the weight is dynamically improved.

After three years of practical teaching, the system found that Projects with higher scores in the ' sustainability ' dimension of industrial design have higher market recognition and industry appeal. According to this, the system automatically increases the weight of this dimension from the original 25 % to 30 %. This weight improvement mechanism based on empirical evidence ensures that the evaluation criteria reflect the development and change of the industry and social needs. The data show that the dynamic weight adjustment significantly improves the correlation between the evaluation score and the actual result.

Interdisciplinary practice shows that the system can well adapt to various disciplines. For the digital media art major, the system sets the weight of balanced technology integration, artistic expression and cultural exchange. For fashion design majors, the system dynamically adjusts the weight between technology application and creative expression according to the difference of design positioning[7]. The research shows that the system ensures a high degree of consistency in the evaluation of interdisciplinary assignments, which not only retains the uniqueness of each discipline, but also ensures the internal consistency of the evaluation criteria.

7 APPLICATION RESULTS AND EMPIRICAL ANALYSIS

Thanks to this progressive teaching practice, the model has shown significant effectiveness in the actual teaching environment; in terms of teaching process diagnosis, the effectiveness of the teaching process has been significantly improved, and teachers ' satisfaction with the system has also reached a high level ; in terms of performance evaluation, the objectivity of evaluation has been significantly improved, which helps to build a more comprehensive and scientific evaluation system. The comprehensive evaluation shows that the overall application of the model significantly improves the accuracy of evaluating teaching excellence and tracking students ' learning progress. In practice, the model promotes the construction of students ' self-assessment ' closed-loop ' mechanism and significantly improves the depth of evaluation results[8]. These data fully prove the validity and reliability of the model in practical applications. Students ' feedback shows that this multi-dimensional assessment method more accurately reflects the true level of students and provides a clear direction for further improvement.

8 CONCLUSIONS AND PROSPECTS

The intelligent evaluation model constructed in this study adopts the systematic theoretical framework and innovative technical means to effectively solve many challenges of education evaluation in the field of art design. This model is the result of the application of artificial intelligence in the field of art design teaching in Shanghai Institute of Arts and Crafts for three years. Its innovation lies in three aspects : the construction of a comprehensive evaluation system based on multi-modal data, the construction of multi-dimensional evaluation criteria and the development of weight dynamic

adaptation mechanism.

The practical value of this model has been fully verified by teaching practice, which not only improves the accuracy and objectivity of evaluation, but also constructs a continuously improved education evaluation ecosystem, which can be felt. With the accumulation of application data, the model will continue to improve and develop, and the evaluation criteria will be more accurate. In the end, the development will become an intelligent mechanism to continuously improve the quality of art design education.

In the future, we will carry out research in three aspects: first, further improve the multi-modal data fusion algorithm to improve the accuracy and real-time performance of the model ; the second is to expand the applicability of the model and enhance its adaptability in the context of interdisciplinary and intercultural education ; the third is to deepen the research on human-computer interaction mechanism and improve the integration of artificial intelligence and teachers ' professional knowledge. We believe that through these continuous efforts, the evaluation of art design education will move towards a deeper level of scientific and humanized unity, and provide solid support for the construction of a future-oriented art education system.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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