Evaluation Model of Adaptive Teaching Ability of College Art Teachers

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Abstract—The existing evaluation models for the teaching ability of college art teachers are unadaptable, unsystematic and incomplete. To solve these problems, this paper puts forward a novel model to evaluate the adaptive teaching ability of college art teachers. Firstly, the teaching demand of college art teachers was analyzed in the knowledge age, highlighting the necessity to evaluate the adaptive teaching ability of college art teachers. Next, an evaluation system was established for the adaptive teaching ability of college art teachers in the knowledge age, and different types of evaluation indices were identified. On this basis, the grey relational analysis (GRA) was introduced to build an evaluation model for the adaptive teaching ability of college art teachers. The GRA-based evaluation model enjoys good operability and feasibility. To sum up, this paper fully integrates the evaluation system and evaluation model for the adaptive teaching ability of college art teachers. The research results have great significance in terms of theoretical innovations and practical applications.

Keywords—Teaching ability, art education, colleges, evaluation system, evaluation model

1 Introduction

In this knowledge age, the application of knowledge has given birth to various advanced techniques, calling for better quality of higher education [1-4]. In the meantime, many emerging techniques, namely, Internet technology [5-6], virtual reality (VR) [7-8] and big data [9-10] have been applied in higher education.

Being an essential part of higher education, college art education is critical to improving the overall quality of modern talents, especially the innovative ability of art talents. Therefore, many scholars engaging in higher education have explored deep into college art education. For example, Lin [11] discussed how to cultivate art talents with the ability to put different types of knowledge into practice. Taking a youth orchestra as an example, Egana-delSol et al. [12] demonstrated the impact of art education on human capital. Tang and Xie [13] investigated a diversity of art teaching methods, starting from discussion-based teaching. Cvetkova et al. [14] discussed the value of several teaching and learning strategies in art education. From the angle of

the integration of theory and practice, Gao [15] analyzed the teaching strategies and methods that promote the creative ability of art students. Candan Dizdar Terviel [16] evaluated the doctoral education of the Fine Arts Department, Hacettepe University, and discussed the training programs and methods aimed at training academic artists in graduate education.

The above studies of art education emphasize on strategy analysis and ability development over the adaptive teaching ability of college art teachers. As the subjects of art education, college art teachers ought to have good ability of adaptive teaching, which guarantees the quality of art talents trained by them. Therefore, it is very meaningful to evaluate the adaptive teaching ability of college art teachers, identify the weaknesses in art education, and provide suitable strategies for college art education.

However, it is a complex and systematic task to evaluate the adaptive teaching ability of college art teachers, for the influencing factors are from various levels and the evaluation indices are highly diverse. Besides, the numerous evaluation indices are often difficult to quantify. As a result, the adaptive teaching ability of college art teachers cannot be directly evaluated by the current methods for engineering analysis of complex systems, such as the systemic analysis based on genetic algorithms (GAs) [17-18], analytic hierarchy process (AHP) [19-20] or information entropy [21-22].

In the light of the above, this paper puts forward an evaluation system for the adaptive teaching ability of college art teachers, and creates an evaluation model for the said ability based on the grey relational analysis (GRA) [23-26].

The remainder of this paper is organized as follows: Section 2 analyzes the teaching demand of college art teachers in the knowledge age; Section 3 establishes an evaluation system for the adaptive teaching ability of college art teachers in the knowledge age; Section 4 builds a GRA-based evaluation model for the said ability; Section 5 puts forward the conclusions.

2   Teaching Demand Analysis of College art Teachers in the Knowledge Age

2.1   Demand for changing the training goals of college art teachers

College art education needs to fit the times and have a scientific outlook on development. In the knowledge age, new art design concepts, theories, ideas, and themes are often generated based on the development of knowledge fusion, which has led to the situation that, in the knowledge age, the goal of art talent education in colleges and universities is not static. The traditional classroom knowledge-based art education often emphasizes only on the cultivation of junior-and-intermediate level art teachers, while neglecting the cultivation of the artistic ability of senior art teachers, so it can't effectively improve the comprehensive quality of senior art teachers. As a result, in the knowledge age, the cultivation of art teachers in colleges and universities must not only focus on the teaching of the basic courses of art majors, but also should strengthen the extended and innovative teaching of art education in colleges and universities; moreover, the art education should consolidate the basic professional and aesthetic

capabilities of art teachers, expand the art vision of senior art teachers, and enhance their practical abilities, so that the cultivated senior teachers could have outstanding professional skills, vocational capabilities, and abilities to innovate and serve the society. For this reason, under the premise of the changing cultivation goal of art teacher education in colleges and universities, how to effectively improve the teaching ability of art teachers in the knowledge age and enable them to adapt to the demands of the cultivation of senior art talents in the new age, is a key link that requires our attention during the implementation of art education in colleges and universities.

2.2 Demand for improving the professional quality of college art teachers

In the context of the new era, classic art works need to be inherited, but the value of art lies not only in inheritance, but also in the recreation based on inheritance, so that new art works, concepts, ideas and other art forms that fit the times and integrate with the development of the society could show up. Innovation, reform, and development have gradually become the main themes in the continuation of the vitality of fine arts, and these have placed higher requirements on the cultivation and education of senior art talents, as well as on the professional quality of the educators of art talents. The diversification of knowledge, art talents, and the social requirements on art talents has improved the public's abilities in art recognition, adsorption and appreciation to vary degrees, and this trend is gradually enhanced with the continuous improvement of people's living standards. If the public' art appreciation has reached a relatively high level, it'll become a pressing matter to improve the professional qualities of art teachers in colleges and universities, otherwise it'll be difficult to cultivate senior art talents that meet the demands of social development and have the characteristics of the times, and thus the public's requirements in art adsorption and appreciation can hardly be satisfied. It can be seen that the cultivation of senior art talents is a job of top priority. The most important link in the improvement of the cultivation quality of art talents is the high-level faculty qualities, thus, improving the professional quality of college art teachers is an urgent job. The professional quality of college art teachers does not refer to the artistic ability of art teachers and how many representative works do they have, but refers to their comprehensive professional ability. The number of representative works can only reflect the artistic accomplishments of college art teachers, but it can't show the level of the teacher's ability to impart art. The comprehensive professional quality of college art teachers is reflected in many aspects, such as the basic teaching ability, curriculum planning ability, teaching reform ability, lecturing ability, and practical innovation ability, etc.; the comprehensive professional quality of college art teachers is an ability that is reflected in the process that integrates the teaching and learning of art.

2.3 Demand for strengthening the social service ability of college art education

Art education is a key link in the modern "moral, intellectual, physical, artistic and labor" education, and it's a necessary and indispensable link in the process of apply-

ing higher education to serving the social development. In the knowledge age, the perspective of the development of art is no longer limited to the artistic value of the art work itself, but emphasizes more on the reflection of the development value and social service value of the work, and using art to exert artistic influence on individuals from different social classes, provide artistic enjoyment for the advancement of the society, and offer positive impetus for the development of the society. In the knowledge age, all art forms are booming and flourishing; as people's material and living standards are improving continuously, their spiritual and cultural demands are also increasing accordingly. Therefore, various countryside cultural activities, academic seminars, expert symposiums, and art knowledge promotions have emerged and penetrated deep into all levels and aspects of the life of common people. The same is true for art education, on the one hand, holding various art master lectures, art exhibitions, art seminars, art work classroom introductions, and countryside art work exhibitions can enhance the public recognition for different art forms, promote the inheritance of excellent classic art works, and enable social groups to feel the appeal of fine arts; on the other hand, these activities can use various forms and methods to make art integrate into people's lives in all aspects, and enhance the spiritual and cultural level of the general public. We know that the emergence and development of a good art form must originate from the society, serve the society and take root in the society, and art education is no exception. Therefore, improving the social service ability and awareness of art education is a new demand in the development of modern society, this also requires the college art education to strengthen students' recognition of the idea that art originates from society, serves the society and takes root in the society in the process of senior art talent education, so that the senior art talents cultivated by higher education can make greater contributions to the development of the society and promote the continuous progress of social spiritual civilization.

2.4 Demand for the reform of art education modes in colleges and universities under the support of new technologies

The emergence of computer technology, network technology, information technology, big data, virtual reality technology, and other technologies have brought a serious impact on the teaching means, teaching methods, and teaching modes of traditional college art education, which makes the traditional art education methods in colleges and universities fail to well adapt to the teaching demands of modern art education. First, in terms of teaching means, the traditional "blackboard & chalk" teaching means is no longer suitable for modern art education. The drastic increase in the information amount of art education, the diversity of art knowledge education, and the dynamic nature of art education content have made the teaching efficiency of existing teaching means extremely low, therefore, we must promote the application of AI, big data, VR, and other technologies in art education. Second, in terms of teaching methods, the traditional classroom teaching method can no longer mobilize the learning interests and enthusiasm of art students in modern colleges and universities, so it's necessary to reform the current teaching methods and increase the practicality, expansion and interaction of art education. During the imparting process of art knowledge,

we should apply modern intelligent technologies, pay attention to the reform and integration of teaching methods, mobilize students' learning initiative and enthusiasm, thereby enhancing the competitiveness of college art education. Third, in terms of teaching modes, the traditional classroom teaching method often makes the college art education limited to textbook content, the involved art knowledge is not as varied, unable to effectively broaden the vision of art students, and can hardly promote their innovation ability. As a result, a variety of teaching modes have appeared such as the flipped classroom, MOOC, the smart classroom, micro lecture, and other teaching apps. It can be seen that with the continuous development of science and technology, many emerging intelligent technologies have emerged, which has put forward new requirements for the concept of art education in colleges and universities; moreover, to effectively improve the teaching quality of art education in colleges and universities, it also proposes demands for the reform of art education modes of colleges and universities.

3 The Adaptive Teaching Ability Evaluation System of College Art Teachers in the Knowledge Age

To make the evaluation more systematic and complete, the construction of the adaptive teaching ability evaluation system of college art teachers is conducted during the implementation process of the college art education, specifically, there are three main links in it: the evaluation of the professional qualities of art teachers, the evaluation of the teaching process of art teachers, and the evaluation of the teaching results of art teachers.

3.1 The evaluation of the professional qualities of art teachers

The evaluation of the professional qualities of art teachers mainly assesses the college art teachers' professional abilities in art teaching and art research. The art teaching professional ability emphasizes on the art teacher's professional ability in art teaching, and this ability should be evaluated from the aspects of the teacher's art knowledge reserve, curriculum planning, and art teaching reform, etc. The specific evaluation indices include: whether the art teacher has a senior title; whether the art teacher has a high education degree; how many high-level representative art works does the art teacher have; how many excellent art textbooks has the art teacher written as the main writer or editor; how many art courses does the art teacher undertake; how much contribution does the art teacher make to the curriculum planning that is in accordance with the professional development; how many provincial, municipal or above level art education reform programs does the art teacher undertake; how many high-level art teaching papers has the art teacher published; how many art education reform awards has the art teacher received; how many high-level art teaching seminars has the art teacher held or participated in. The art teaching research ability emphasizes on the art teacher's professional ability in art research, and this ability should be evaluated from the aspects of the teacher's research knowledge level, research

program implementation, and research result transformation, etc. The specific evaluation indices include: the construction of the art major scientific research platform; how many art major graduates have been educated by the art teacher; how many domestic or international art research conferences has the art teacher undertaken or participated in; how many provincial, municipal or above level art research programs does the art teacher undertake; how many art major academic monographs has the art teacher written; how many high-level papers has the art teacher published; degree of integration of art teaching and art research; and art research result transformation, etc.

3.2 The evaluation of the teaching process of art teachers

The evaluation of the teaching process of art teachers is mainly to evaluate the art teacher's teaching means, teaching methods, teaching contents, teaching forms, teaching effects, and teaching attitude, etc. The art class teaching means focuses on assessing whether the art teacher has applied various intelligent technologies in the art teaching process, that is, to investigate whether the art teacher's teaching means is diverse, flexible, proper, and advanced. The teaching method focuses on assessing whether the art teacher has comprehensively applied various teaching methods, that is, to investigate whether the art teacher's teaching method is targeted, representative, and interactive. The teaching content focuses on assessing whether the art teacher has fully exhibited his/her professional art knowledge during the art teaching process, that is, to investigate whether the art teacher's teaching content is systematic, contemporary, substantial, and integrated. The teaching form focuses on assessing whether the art teacher has integrated art theory and art practice into the art teaching process, that is, to investigate whether the art teacher's teaching form is extended, comprehensive, and scientific. The teaching effect focuses on assessing whether the art teacher has fully mobilized the learning atmosphere during the art teaching process, that is, to investigate whether the art teacher's teaching effect is multi-dimensional, interesting, and applicable. The teaching attitude focuses on assessing the attitude and behavior of the art teacher during the art teaching process, that is, to investigate whether the art teacher's teaching attitude is correct and his/her teaching behavior is proper.

3.3 The evaluation of the teaching results of art teachers

The evaluation of the teaching results of art teachers is mainly to quantitatively assess the art teacher's teaching results, including the art class teaching result evaluation, the art practice teaching result evaluation, the art social service result evaluation, and the art students' research result evaluation, etc. The art class teaching result evaluation is mainly to assess the specific effects of art classroom teaching, including the students' attendance rate; the activeness of classroom atmosphere; the students' scores and exam passing rate; the students' satisfaction; the teaching supervisors' satisfaction, and the students' churn rate, etc. The art practice teaching result evaluation emphasizes on assessing the specific effects of the teaching of artistic practice, including: the number of times the art students participating in social sketching; the number of times the art students participating in art contests; the number of art students who

have received awards in provincial, municipal or above level art contests; and the satisfaction of art teaching supervisors, etc. The art social service result evaluation is mainly to assess the art education's social service ability and its contributions, including the number of times the art students participating in social heart-warming projects; the number of art students participating in art work exhibitions; the social service participation rate of art students; and the art students' social service contribution rate and satisfaction degree, etc. The art students' research result evaluation mainly focuses on assessing the art students' artistic research and innovation abilities, including: the art students' participation situation in art research projects; the number of high-level papers published by the art students; whether the art students have the ability to conduct art research by themselves; and whether the art students have the ability to create innovative art works, etc.

4 GRA Model of the Adaptive Teaching Ability of College Art Teachers

4.1 Gray classic domain and section domain of evaluation indices

To effectively quantify and evaluate the adaptive teaching ability of college art teachers, distinguish the teaching levels of the art teachers to be assessed, and find out the advantages and disadvantages in the adaptive teaching ability of college art teachers, it's necessary to classify the evaluation indices of the adaptive teaching ability of college art teachers. According to the above-mentioned evaluation system of the adaptive teaching ability of college art teachers, it can be known that the corresponding evaluation indices include both the qualitative description indices and the quantitative description indices. Therefore, combining with the hierarchical characteristics of the evaluation indices of the adaptive teaching ability of college art teachers, the corresponding classic domains and section domains of the indices under different levels should be established. Assuming there are n evaluation indices in all; the i-th evaluation index is divided into m evaluation levels, then the classic domain of the j-th evaluation level of the i-th evaluation index represents the value range of the i-th evaluation index under this level.

For the quantitatively described evaluation indices of the adaptive teaching ability of college art teachers, the classic domain is expressed as:

$$V_{ij} = \left[v_{ij}^{min}, v_{ij}^{max} \right], v_{ij}^{min} \leq v_{ij}^{max} \tag{1}$$

For the qualitatively described evaluation indices of the adaptive teaching ability of college art teachers, the classic domain is generally expressed by fuzzy language, and its fuzzy membership range is the corresponding classic domain, which is expressed as:

$$V_{ij} = \left[v_{ij}^{min}, v_{ij}^{max} \right] = \left[\phi_{ij}^{min}, \phi_{ij}^{max} \right], \left(v_{ij}^{min} = \phi_{ij}^{min} \right) \leq \left(v_{ij}^{max} = \phi_{ij}^{max} \right) \tag{2}$$

The section domain corresponding to the i-th evaluation index is expressed as:

$$V_i = \left[v_i^{min}, v_i^{max} \right] = \left[\min_{1 \leq j \leq m} \left(v_{ij}^{min} \right), \max_{1 \leq j \leq m} \left(v_{ij}^{max} \right) \right], v_i^{min} \leq v_i^{max} \tag{3}$$

4.2 Quantitative analysis of evaluation indices

From the evaluation system of the adaptive teaching ability of college art teachers, it can be seen that not only the evaluation indices of the adaptive teaching ability of college art teachers need to be divided into different classic domains, for different type college art teachers, the evaluation indices often require to have different dimensions. In order to make the evaluation of the adaptive teaching ability of college art teachers has a unified criterion, and improve the reliability and accuracy of the evaluation, it's necessary to conduct unified quantitative analysis on the evaluation indices of different dimensions.

For the evaluation indices that quantitatively describe the adaptive teaching ability of college art teachers, if the i-th evaluation index is a benefit-based index, then after unified quantification, its value is:

$$U_{ij} = \left[u_{ij}^{min}, u_{ij}^{max} \right] = \left[\frac{v_{ij}^{min} - v_i^{min}}{v_i^{max} - v_i^{min}}, \frac{v_{ij}^{max} - v_i^{min}}{v_i^{max} - v_i^{min}} \right] \tag{4}$$

If the i-th evaluation index is a cost-based index, then after unified quantification, its value is:

$$U_{ij} = \left[u_{ij}^{min}, u_{ij}^{max} \right] = \left[\frac{v_i^{max} - v_{ij}^{min}}{v_i^{max} - v_i^{min}}, \frac{v_i^{max} - v_{ij}^{max}}{v_i^{max} - v_i^{min}} \right] \tag{5}$$

For the evaluation indices that quantitatively describe the adaptive teaching ability of college art teachers, since their fuzzy membership degree has uniform measurement characteristics, after unified quantification, their values are the corresponding fuzzy membership degrees, which can be expressed as:

$$U_{ij} = \left[u_{ij}^{min}, u_{ij}^{max} \right] = \left[\phi_{ij}^{min}, \phi_{ij}^{max} \right] \tag{6}$$

After the above-mentioned unified quantitative analysis and processing, all evaluation indices now have a same measurement standard.

4.3 Evaluation and analysis process of GRA

Assume there is an object P to be assessed in the evaluation of the adaptive teaching ability of college art teachers, the value of the i-th evaluation index of object P is

$U_i^P = [u_i^{P-min}, u_i^{P-max}]$, $u_i^{P-min} \leq u_i^{P-max}$, then the gray comparison sequence YP of object P with respect to all evaluation indices is:

$$\boldsymbol{Y}_P = \left\{ U_1^P, U_2^P, \cdots, U_i^P, \cdots, U_{n-1}^P, U_n^P \right\} \tag{7}$$

Similarly, the gray reference sequence Yj of the j-th classic domain of all evaluation indices of the adaptive teaching ability of college art teachers is expressed as:

$$\boldsymbol{Y}_j = \left\{ U_{1j}, U_{2j}, \cdots, U_{ij}, \cdots, U_{(n-1)j}, U_{nj} \right\} \tag{8}$$

The distance Dij between the gray comparison sequence YP and the gray reference sequence Yj about the i-th evaluation index of the adaptive teaching ability of college art teachers is expressed as:

$$D_{ij} = \frac{\left| u_i^{P-min} - u_{ij}^{min} \right| + \left| u_i^{P-max} - u_{ij}^{max} \right|}{2} \tag{9}$$

There is:

$$\Psi_{ij}(max) = \max_i \max_j \left| D_{ij} \right| = \max_i \max_j \left(\frac{\left| u_i^{P-min} - u_{ij}^{min} \right| + \left| u_i^{P-max} - u_{ij}^{max} \right|}{2} \right) \tag{10}$$

$$\Psi_{ij}(min) = \min_i \min_j \left| D_{ij} \right| = \min_i \min_j \left(\frac{\left| u_i^{P-min} - u_{ij}^{min} \right| + \left| u_i^{P-max} - u_{ij}^{max} \right|}{2} \right) \tag{11}$$

Then, for the object P to be assessed in the evaluation system of the adaptive teaching ability of college art teachers, its gray correlation coefficient ρP-ij between the i-th evaluation index and the j-the classic domain is:

$$\rho_{P-ij} = \frac{\Psi_{ij}(min) + \beta * \Psi_{ij}(max)}{\left| D_{ij} \right| + \beta * \Psi_{ij}(max)} \tag{12}$$

4.4 Implementation of the multi-dimensional GRA model

If the weight of the i-th evaluation index is wi, then the weighted gray correlation ξP-j between the object P and the j-th classic domain is:

$$\xi_{P-j} = \sum_{i=1}^{n} \left(w_i * \rho_{P-ij} \right) \tag{13}$$

In order to make the evaluation of the adaptive teaching ability of college art teachers more comprehensive and consistent, the multi-dimensional evaluation method is required for the analysis, that is, the evaluation of the objects can be conducted by various methods, such as social evaluation, school evaluation, teacher peer review evaluation, and students evaluation, etc. Assuming there are K dimensions in the evaluation of the adaptive teaching ability of college art teachers; the weight of the k-th dimension is wk; therefore, in the k-th dimension, the weighted gray correlation ξ_{P-j}^k between the object P and the j-th classic domain is:

$$\xi_{P-j}^k = \sum_{i=1}^{n} \left(w_i * \rho_{P-ij}^k \right)$$

(14)

where, ρ_{P-ij}^k is the gray correlation coefficient between the i-th evaluation index and the j-th classic domain of object P.

Then the comprehensive weighted gray correlation ξj between the object P and the j-th classic domain in multiple dimensions is:

$$\xi_j = \sum_{k=1}^{K} \left(w_k * \xi_{P-j}^k \right)$$

(15)

According to the optimization principles of the evaluation of the adaptive teaching ability of college art teachers, if the equation below is satisfied:

$$\zeta_q = \max_{1 \le j \le m} \left(\xi_j = \sum_{k=1}^{K} \left(w_k * \xi_{P-j}^k \right) \right), \quad 1 \le q \le m$$

(16)

It indicates that the evaluation of the adaptive teaching ability of object P belongs to the q-th classic domain.

5 Conclusion

This paper conducted analysis on the teaching demands of college art teachers from four aspects: namely the demand for changing the training goals of college art teachers; the demand for improving the professional quality of college art teachers; the demand for strengthening the social service ability of college art education; and the demand for the reform of art education modes in colleges and universities under the support of new technologies. Then, this paper systematically and comprehensively constructed an evaluation system for the adaptive teaching ability of college art teachers from the three perspectives of the evaluation of the professional qualities of art teachers, the evaluation of the teaching process of art teachers, and the evaluation of the teaching results of art teachers. Moreover, combining with the types of the evaluation indices of the adaptive teaching ability of college art teachers, this paper constructed a GRA model for the adaptive teaching ability of college art teachers, and

realized the multi-dimensional and hierarchical evaluation of the adaptive teaching ability of college art teachers. By combining theoretical evaluation system with practical application model, this study had effectively solved the problem of the evaluation of the adaptive teaching ability of college art teachers, and the method proposed in this paper is of high adaptability.

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7 References

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