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## A RESEARCH ON THE TEACHING REFORM PATH OF " INTERNET PLUS EDUCATION ": EVIDENCES FROM ART DESIGN TEACHING IN CHINESE UNIVERSITIES

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## ABSTRACT

Classroom teaching is the main way to realize talent development in colleges and universities, and it is also the main carrier and important form of knowledge transmission in colleges and universities. With the deep integration of "Internet +" and education and teaching, the trend of intellectualization and multimedia of classroom teaching in colleges and universities is increasingly obvious. However, "Internet + education" shows the phenomenon of imbalance in the classroom teaching of some colleges and universities, which leads to the low efficiency of classroom teaching. Based on the current context, our research deeply analyzes the current situation and problems of teaching development in Chinese universities from the perspectives of teacher, students and teaching management department, and on this basis, we put forward an evaluation idea of combining Fuzzy Mathematics and System Science. The core of the evaluation idea is intuitive fuzzy set theory. In the research, we define an improved score function based on intuitive fuzzy cross-entropy, and give a calculation method of the combination weight for the G1-entropy method, which is essentially a method of subjective and objective empowerment. Based on the "Internet+education", we have built the quality evaluation index system for art teaching classroom of Chinese universities. The index system consists of one level index, three second-class indexes, and nine third-class indexes. We completed the importance sequencing of nine indexes by applying the evaluation method of intuitionistic fuzzy set mentioned in this research, and we also put forward relevant suggestions. We verify the applicability and scientificity of the method. Our research has realized the improvement of methods, theoretical innovation and practical application. Our research is leading-edge and advanced. Our research can not only provide suggestions of policy guidance for Chinese educational departments, but also provide experience for the teaching reform of international higher education.

**Key words:** Internet Plus Education, Teaching Reform, Intuitive Fuzzy Set Theory, G1-Entropy Method, Index Importance Ranking

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## **1 INTRODUCTION**

"Internet +" is "Internet + various traditional industries". The Internet is a technical way and the Internet can be applied to other traditional fields, such as "Internet + finance", "Internet + medical care", "Internet+tourism", etc. The Internet information technology can be integrated with many fields of human life. This is not only a form, but also the application of Internet technology in various traditional fields. In addition, it can play the optimization and integration role of the Internet in the allocation of social resources. Let the Internet +" ecological model will be based on the Internet."Internet+education" is not a completely new Internet industry. From network education to online education, the Internet was initially only used as an assisted tool in traditional education and teaching, and did not form its own independent system of application. Through the Internet thinking, Internet approach, Internet platform, it changes the traditional education with teaching authority as the core of education mode, into a learner or user original learning content, independent learning in the new education mode.

There are many teaching modes of "Internet + education", such as online education and online reading. With the deep integration of information technology and education and teaching process, as well as the current COVID-19 epidemic prevention needs, online teaching has become the normal phenomenon. In order to prevent online teaching from simply replacing offline teaching, the discussion on the mode of combining online and offline education has become the main research content of "Internet+education". The Ministry of Education of the People's Republic of China united the central net letter, the National Development and Reform Commission, Ministry of Industry and Information Technology, Ministry of Finance and the People's Bank of China to issue the document about promoting education new infrastructure construction to build highquality educational support system, aiming to strengthen educational new construction and promote the development of online teaching integration, promote education digital transformation, intelligent upgrade, fusion innovation, support high-quality development of educational reform. From the level of teachers, the opinions point out that teachers should do an effective integration of three different teaching scenarios of offline traditional classroom, online live classroom and online recorded classroom, and do a good job in the teaching evaluation of students in the three scenarios. In the whole teaching design, the selection of teaching scenarios, various resources, evaluation methods, education modes and other choices is constantly increasing. How to choose to achieve the effective integration of resources is the main problem that every educator needs to consider. Through the discussion of the reform path of online and offline education mode, the classroom is given to students to realize student activities as the center, fully mobilize students' subjective initiative, and achieve the purpose of education. On February 5,2020, the Ministry of Education of China issued the Guidance on the Organization and Management of Online Teaching in Regular Institutions of Higher Learning during the epidemic period. In response to the impact of COVID-19 on the normal opening and classroom teaching in colleges and universities, the guideline requires government-led, college subject and social participation to jointly implement and ensure online teaching in universities during the epidemic prevention and control period, so as to achieve "school suspension and teaching". On March 21,2020, the Steering Committee of Chinese Higher Education Institutions issued the Guidelines on Further Improving Online Physical Education Teaching during the COVID-19 period, aiming to promote online physical education for college students during the epidemic prevention and control period. On May 15,2020, China's Ministry of Education issued the online education from "fresh" to "new normal", requires the formation of some vivid practice into outbreak after the important measures of education teaching reform, including ideas, ideas, content, methods, technology, standards, evaluation, paradigm, etc, a set of reform plan. On July 16,2021, China's Ministry of Education, the national health committee jointly issued " on further strengthening the epidemic prevention and control normalized school health management notice, stressed that teachers and students to strengthen the epidemic prevention and control consciousness, points out the normalized epidemic prevention and control in the school health management work need to carry out the requirements and measures.

During the period of COVID-19, the online teaching in colleges and universities has realized the online class education in all regions in the way of using comprehensive measures. On May 8, 2020, 1,454 universities in China had conducted online teaching.1.03 million Teachers offered 1.07 million courses online, totaling 12.26 million courses, including theoretical and experimental courses; 17.75 million college students attended online learning, totaling 2.3 billion people. According to December 17,2021, the Chinese Ministry of Education issued the national college undergraduate education teaching evaluation (2020), according to the expanding online teaching scale, the national undergraduate universities a total of 1.08 million teachers of 1.1 million courses, a total of 17.19 million courses, online learning students a total of 3.5 billion, the national online course rate reached 91%, teachers online teaching recognition reached 80%, students online teaching satisfaction rate reached 85%.

Based on the above background and the current status of the relevant data, Our study mainly has these three contributions: (1) the methodological level, By sorting out the current situation and problem analysis of the teaching classroom in domestic colleges and universities, The university classroom teaching quality evaluation model suitable for the COVID-19 period under the background of "Internet+education" was constructed, It provides an intuitive fuzzy evaluation method to improving score function and a subjective and objective empowerment method combining G1 method-entropy method; (2) Applied and practical level, After we have completed the construction of the university classroom teaching evaluation index system, we calculate the index weights by using the method of subjective and objective empowerment, take the Chinese art teaching as the case analysis object, Completed the importance of the indicators to evaluate the quality of art teaching classroom ranking; (3) Countermeasures and suggestions level, Based on results of the study in (1) and (2), Put forward some suggestions on improving the quality of classroom teaching reform in universities combined with "Internet + education" during COVID-19, To help support China's education authorities to formulate relevant policies, It can also provide experience for many international universities to evaluate the teaching quality.

The rest of this article is arranged as follows: The second part is a literature review of this article, It mainly summarizes the results of the international "Internet+education" research, teaching research and teaching quality assessment methods during the COVID-19 period; The third part introduces the development status and problems of classroom teaching in Chinese universities; Part four is the basic theory, Including the intuitive fuzzy set, score function, G1 method and entropy method; The fifth part proposes a new method of calculating the importance of university teaching evaluation index under "Internet+education"; Part six is the case analysis, Take the art teaching courses in Chinese universities as an example; The seventh part puts forward the relevant countermeasures of "Internet+education" in the reform of university art teaching under the background of COVID-19; Part 8 explains why we conducted this study, That is, the significance of this study; The ninth part is the conclusions of this article.

#### 2 Literature review

Countries have offered a lot of policy support for teaching reform during the situation of COVID-19 epidemic. We also see in the current new crown outbreak of the "Internet+education" related data, it is necessary to more thorough study "Internet+education" under the background of teaching mode reform path, make directional guidance for our follow-up work. We will conduct a literature review from three aspects, namely, "Internet + education" research, teaching reform, teaching evaluation, teaching design research and teaching quality evaluation during the COVID-19 period.

There is a lack of literature on "Internet + education" research. We explored the relevant literature about online and offline teaching research. Zeng Wenying<sup>[1]</sup> and other researchers explored the application methods and ways of big data and artificial intelligence in the teaching and practice of vocational education, and illustrate the practice of innovative application of software technology. We are grateful for this study, and they were very inspired by our study. Sun ML and other researchers improved fragmented, personalized and socialized education, which is a new feature of accounting education in the Internet era, and discussed the reform of accounting education mode in the "Internet +" era, and improved the learning efficiency by improving the teaching mode.

Based on the virtual reality technology, Yi Ding<sup>[2]</sup> designs and proposes a university sports virtual reality system that composes of the Internet of Things, cloud platform and mobile client. Cai JY<sup>[3]</sup> presents a solution in a PE teaching and research support environment based on emerging information technologies such as the Internet of Things and multimedia technologies. The above three studies have studied the education and teaching reform of different subjects under the "Internet + education" mode from different perspectives, which has benefited us a lot and provided us with many new ideas for our research. Hao L and other researchers discussed the advantages of large-scale open online course teaching, provided new ideas and methods for the diversification of online course teaching in colleges and universities, and put forward corresponding solutions and suggestions for the shortcomings of the existing development. Silv<sup>[4]</sup> and other researchers investigated several contexts for the application of Internet technology in learning and more effective management of educational organizational structure, identifying the Internet of Things tools applied in educational environment to help the decision-making process in education. By mapping data sources, Moreira FT<sup>[5]</sup> finds that the application of the Internet of Things in education has a great potential in obtaining real and constantly updated data. Ma HX proposed a design course based on mobile Internet model, applied to the innovation and improvement of digital media education based on mobile Internet technology. Adbel-Basset<sup>[6]</sup> demonstrates the role of the Internet of Things in the construction of intelligent education, and the Internet plays a positive role in making effective decisions. These scholars have studied the ways, ideas, modes and advantages of "Internet+education", which can support the theory and methods of this study.

With the regular teaching work of COVID-19, there is a rich research on teaching reform, teaching evaluation and teaching design during the situation of COVID-19 epidemic. We explored relevant research literature on class teaching during the situation of COVID-19 epidemic. Currie G<sup>[7]</sup> discusses the challenges that COVID-19 can pose personally and professionally challenging, but it also provides the opportunity to objectively reevaluate and redesign higher education; Darici D<sup>[8]</sup> studied that during the COVID-19 pandemic, The feasibility and effectiveness of distance teaching in anatomy, It proves that the implementation of course histology is possible in technology; Zhao Y<sup>[9]</sup> and other scholars showed that online teaching during COVID-19 is necessary. Problems that were found in online teaching can be partially solved through innovative teaching and evaluation methods, Did not create teaching resources on the Internet to provide useful ideas. This study is very similar to our research thinking in this paper. We plan to analyze the current situation and problems of college teaching, A set of teaching quality evaluation system suitable for "Internet + education" is proposed. Fatani TH<sup>[10]</sup> discusses the necessity and innovation of remote online learning education activities during COVID-19. The EI said GR<sup>[11]</sup> surveyed a university in Egypt that has suddenly switched from faceto-face to online learning due to the COVID-19 blockade, comparing 576 online students and 372 students through face-to-face teaching. These studies have made us realize that online teaching during COVID-19 is necessary, and we are very grateful for their research ideas for our experience to propose relevant teaching quality assessment methods in this study. Mircea M and other researchers<sup>[12-14]</sup> proposed an assessment model based on six hypotheses and verified the model according to the Romanian Higher Teaching Quality Assessment System and a set of survey data. Delgado  $F^{[15]}$  has conducted a quantitative assessment of the quality of online courses during COVID-19 in Mexico, which helps institutions assess whether the digital strategy implemented in the curriculum has met the original premise and objectives. Tang B made a quantitative evaluation of the course quality of the network during C OVID-19, and proposed a comprehensive evaluation method combining hierarchical analysis method and fuzzy comprehensive evaluation method. Luo  $Y^{[16]}$  studied the neural network technology of error backpropagation algorithm to establish the art teaching quality evaluation model during COVID-19, and verified the effect of the network model training method of error backpropagation algorithm, and achieved the expected results. The above research put forward the teaching quality assessment method from different perspectives, which provides our empirical reference for this study. Tang T<sup>[17]</sup> demonstrated that the model of combining network teaching and flipped teaching can improve students' academic performance and course evaluation quality better than the traditional model. Tabatadze S<sup>[18]</sup> demonstrates that professional educational teaching development activities during COVID-19 are more effective and useful. In order to assess the current situation of overall anatomical education in COVID-19 China, Cheng X<sup>[19]</sup> conducted a national survey via email and social media respondent invitation that, despite requiring a lot of work, provided valuable digital information for subsequent research.

The Huanag RH<sup>[20]</sup> findings can help researchers and educators apply open educational resources and open teaching realities during COVID-19 to achieve a better learning experience and outcomes. This is studied from the perspective of educators, and can effectively help every teacher involved in online teaching. Wang  $T^{[21]}$  used the partial least squares structure equation model to study the willingness of college students to learn online during the epidemic period, and put forward suggestions on the model and methods of promoting online learning in universities after the COVID-19 epidemic. The Witt T<sup>[22]</sup> investigated the digital effects of teaching courses during the COVID-19 outbreak, demonstrating that digital education itself has not made it easier or more difficult for learners, but that gaps in student understanding and performance have increased in the digital teaching era. Karagul BI<sup>[23]</sup> examined the student level of digital literacy during COVID-19, demonstrating that there was a statistically significant relationship between student digital literacy and gender and education, and that age was not a statistically significant variable. The above three studies focus more on the students' perspective, which can help us to better evaluate the classroom teaching effect, and transform the teacheroriented classroom into a student-oriented classroom. Azar AJ<sup>[24]</sup> introduces an effective teaching approach based on the design, implementation, and evaluation of a distance learning framework suitable for medical schools to address student learning problems during the C OVID-19 pandemic. Pocsova J<sup>[25]</sup> studied the teaching methods of improving the online mathematics teaching model during C OVID-19, demonstrating that distance learning does not affect outstanding students or eliminate the number of failed students. The above two studies gave us a lot of inspiration in the "Internet + education" teaching methods research, and we really appreciate the above two research results. Rupnow RL<sup>[26]</sup> investigated university professors' measures to improve courses from offline to online during COVID-19 through four main factors: personal factors, teacher factors, curriculum structure and cultural background factors. Sarfaraz demonstrated the ability of medical teacher online teaching online student participation, teaching strategies, technical communication, and time management by evaluating the self-perceived ability of medical teachers in electronic teaching and support during COVID-19. Said gives six suggestions for teaching reform by studying the online teaching curriculum design and combining with the actual teaching research during C OVID-19. Varma<sup>[27]</sup> discusses the need to use more digital tools and representative software on the online teaching of architectural design during COVID-19, which will be a hybrid learning process in the future. The Domingue  $Z^{[28]}$  study evaluates the effectiveness of a digital application, through a service learning program that develops primary education undergraduate teaching competency in a non-face-to-face teaching environment during COVID-19. Singh's research<sup>[29]</sup> provides advice on how academic management can redesign teaching content, web tool use options, and teaching assessments during COVID-19 to alleviate inequalities in learning styles and scenarios. In short, during the period of C OVID-19 teaching research, involving teaching reform, teaching evaluation, media use and teachers and students satisfaction, these research results make us clear the research direction and goal, for the core research "Internet+education" under the background of online teaching quality assessment provide theoretical and practical support value.

In terms of teaching quality evaluation, we have collected relevant literature on the construction of teaching index system, quality evaluation and evaluation methods, which can see the relevant research results at home and abroad. Li  $W^{[30]}$  starts with the construction of curriculum evaluation indicators, and divides the curriculum evaluation into three stages: development stage, implementation stage and construction stage.Construct the evaluation index system of multiple feedback courses, combine the quantitative analysis method and the qualitative analysis method, and solve the problems of ignoring the evaluation process of the current application-oriented undergraduate courses<sup>[31]</sup>.This study is very meaningful and provides a good reference for the construction of our evaluation indicators in this study.The Song ZQ<sup>[32]</sup> completed the comprehensive evaluation of the virtual teaching environment by selecting multiple indexes, performing the SPSS factor analysis-principal component analysis, and determining the weight of each teaching index.Liu H<sup>[33]</sup> conducts research from the four main aspects of practice teaching management, base construction, content design and implementation, quality evaluation and feedback, and constructs a comprehensive quality evaluation system of general practice training environment.Yang J<sup>[34]</sup> has proved that the fuzzy comprehensive evaluation method combining subjective evaluation and objective evaluation is a scientific and feasible method of nursing education.

Qian L<sup>[35]</sup> proposed a construction method of bilingual teaching quality evaluation model based on network resource sharing, and established a fuzzy comprehensive evaluation matrix through hierarchical analysis method. This research course effectively improves the quality of bilingual teaching and the satisfaction of teachers and students. Huang H<sup>[36]</sup> and other researchers proposed a new analysis method for teaching quality evaluation indicators and visualize the indicators and data. This study<sup>[37]</sup> demonstrates that the teaching quality evaluation is realized through the teaching evaluation system, which is of great significance to improve the effectiveness of classroom teaching."Internet + education" under the background of teaching quality assessment in colleges and universities is actually a multiple attribute decision problem, multiple attribute decision a about multiple related properties of limited choice, due to the complexity of the actual decision and decision makers limitation, cognitive evaluation information and attribute weight is difficult to use accurate value.Zadeh<sup>[38]</sup> first proposed to use the fuzzy set to process the evaluation information of uncertainty and fuzzy<sup>[39, 40]</sup>, but the fuzzy set characterizes the fuzzy information through a single membership, which is difficult to meet the actual decision needs. Since then, scholars have carried out a series of extension of the fuzzy set, successively proposing intuitive fuzzy set, Pythagorean fuzzy set, hesitation fuzzy set, etc. The development of fuzzy set theory proposes the intuitive fuzzy set theory from Atanassov, which uses membership, non-membership and hesitation to describe the ambiguity of decision events, which makes the description of things more accurate and close to the factual decision. However, the score function given by the intuitive fuzzy set is more limited, see the description below. However, we are grateful for the existing description of the intuitive fuzzy set, which allows us to provide theoretical reference to design an intuitive fuzzy set decision method to improve the scoring function<sup>[41-43]</sup>.

In general, the international and domestic about the teaching quality assessment, during the outbreak of teaching research and "Internet + education" teaching quality research has made some good results<sup>[44, 45]</sup>, both from the perspective and research object, have certain relevance with the research, can expand from the theory. practice and research methods of the research vision and ideas, it is because of the research results, the research can smoothly.yet, The current research is not fully applicable to the research topic selection of this paper, And the related research methods need to be further improved in this paper, The specific manifestations are as follows: (1) there are few international and domestic problems concerning teaching quality assessment during the COVID-19 period, A systematic knowledge system is not yet formed, However, in the current situation of COVID-19 normalization, It is particularly necessary to study the quality of teaching during the COVID-19 pandemic, Therefore, it is necessary to systematically analyze the current situation of university teaching, Therefore, a teaching quality evaluation system suitable for the COVID-19 stage is proposed; (2) Regarding the problem of index construction, Although the research perspective of the international and domestic literature has been more comprehensive, However, there is a lack of research on combining "Internet + education" and the construction of teaching quality indicators during the COVID-19 period, but in fact, This is one of the important steps in the research of teaching quality assessment under the new situation, Therefore, it is necessary to construct the index system pertinently and systematically; (3) At present, most of the international and domestic issues on teaching quality assessment stay in the theoretical and methodological stage, We acknowledge that the entropy method, G1 method, intuitive fuzzy set, TOPSIS, But few studies follow the context of practical problems, Through the analysis of the evaluation results, The research literature to support practical applications, One of the biggest contributions of this study is the combination of theory and practice, To support the college teaching under the current situation, In particular, the reform and improvement of art teaching quality in colleges and universities is of great theoretical and practical significance.

## **3** Theoretical method

## 3.1 Intuitionistic fuzzy set and scoring function

Definition<sup>[46]</sup>: Assuming X is a given domain, then an intuitionistic fuzzy set on X can be written as:

$$I = \left\{ \left\langle x, \mu_A(x), \theta_A(x) \right\rangle \middle| x \in X \right\}$$
(1)

where  $\mu_A(x)$  and  $\theta_A(x)$  are the membership degree and non-membership degree of the element x in the universe of discourse X belonging to A, and  $\mu_A(x) \in [0,1]$ ,  $\theta_A(x) \in [0,1]$ ,  $0 \le \theta_A(x) + \mu_A(x) \le 1$ .

 $\pi_A(x)$  is the hesitation degree by x to A, denoted as:

$$\pi_A(x) = 1 - \mu_A(x) - \theta_A(x) \tag{2}$$

For convenience, the intuitionistic fuzzy set can also be denoted as  $A = \langle \mu_A(x), \theta_A(x), \pi_A(x) \rangle$ . In an intuitionistic fuzzy set A, its membership degree  $\mu_A(x)$ , non-membership degree  $\theta_A(x)$  and hesitation degree  $\pi_A(x)$  indicate the degree of support, opposition and neutrality for any element x belonging to the intuitionistic fuzzy set A. The scoring function S(A) is a sorting idea that converts intuitionistic fuzzy numbers into specific numerical values to determine the sorting relationship of fuzzy sets<sup>[47]</sup>.

$$S(A) = \mu_A(x) - \theta_A(x) \tag{3}$$

The scoring function represents the difference between the membership degree and the non-membership degree of the intuitionistic fuzzy number. The larger the difference, the larger the intuitionistic fuzzy number, but the scoring function ignores the influence of hesitation degree  $\pi_A(x)$  on decision-making. If two intuitionistic fuzzy numbers have the same difference but the membership and non-membership are different

intuitionistic fuzzy numbers have the same difference but the membership and non-membership are different, it will be difficult to compare the numbers.

<sup>[48]</sup>defined the exact function S(A) of intuitionistic fuzzy numbers as:

$$S(A) = \mu_A(x) + \theta_A(x) \tag{4}$$

where the larger the value of S(A), the more known information of the scheme, and the better the scheme.

But the exact function must be used together with the scoring function to get the magnitude of the intuitionistic fuzzy number.

considered the hesitation degree into the scoring function, and used the parameter  $\lambda$  to reflect the influence of the hesitation degree  $\pi_A(x)$ . The improved scoring function proposed by Ye<sup>[49]</sup> is given by:

$$S(A) = \mu_A(x) - \theta_A(x) + \lambda \pi_A(x)$$
(5)

where  $\lambda \in [0,1]$ . However, it is difficult to find a reasonable basis for determining the value of  $\lambda$ . So, the value of the intuitionistic fuzzy number cannot be scientifically and reasonably reflected by the scoring function.

## 3.2 Weight calculation method based on subjective and objective weighting

(1) Subjective weighting method - G1 method

The G1 method<sup>[50]</sup> is a subjective weighting method based on the improvement of the traditional AHP method. It can not only meet the requirements of the consistency test, but also avoid the disadvantages of large amount of calculation, many calculation processes and inaccurate results in the AHP method. It is suitable for the calculation of indicator weights at the same level. **Fig. 1** shows the steps for calculating indicator weights using the G1 method.



In Fig. 1, *n* is the number of indicators;  $w_k$  is the weight of the *k*th indicator;  $r_k = \frac{W_{k-1}}{W_k}$  is the ratio of the importance of

the previous indicator to the next indicator. The specific assignment of  $r_k$  is shown in **Table 1** below

	<b>Table.1</b> Reference table for assignment of $r_k$							
$r_k$	Assignment description							
1.0	Indicator $k-1$ is as important as indicator $k$							
1.2	Indicator $k-1$ is slightly more important than indicator $k$							
1.4	Indicator $k-1$ is significantly more important than indicator $k$							
1.6	Indicator $k-1$ is strongly important compared to indicator $k$							
1.8	Indicator $k-1$ is extremely important compared to indicator $k$							

(2) Objective weighting method entropy method

The entropy value method in the objective weighting method is used to objectively assign the decision indicator. It calculates the information entropy of the indicator and determines the weight of the decision indicator according to the relative change degree of the indicator on the system as a whole. The larger the relative change degree, the higher the weight. The steps to determine the indicator weight by the entropy method are as follows:

Step 1: Data normalization

Since there are differences in the dimension and order of magnitude in the evaluation indicators, it is necessary to eliminate the influence of different dimensions on the evaluation results. First, the maximum and minimum methods are used to normalize the indicators.

$$c_i = \frac{x_i^{\max} - x_i}{x_i^{\max} - x_i^{\min}}$$
(6)

where  $c_i$  is the normalized value of the indicator;  $x_i^{max}$  is the maximum value of the *i*th indicator;  $x_i^{min}$  is the minimum value of the *i*th indicator;  $x_i$  is the value of the *i*th indicator.

Step 2: Determine information entropy and information utility value

The information utility value  $I_i$  of an indicator depends on the difference between the information entropy  $E_i$  of the indicator and 1. The larger the difference is, the greater the information utility value and the greater the weight.

$$E_i = -\frac{1}{\ln n} \sum_{i=1}^n p_i \ln p_i \tag{7}$$

$$p_i = \frac{c_i}{\sum_{i=1}^{n} c_i}$$
(8)

$$=1-E_{i}$$
(9)

Step 3: Determine the weight value of each decision indicator

Calculating the weight value of an indicator by the entropy method is to use the information value of the indicator for calculation. The higher the value, the greater the importance of the evaluation.

$$G_i = \frac{I_i}{\left(n - \sum_{i=1}^n E_i\right)} \tag{10}$$

$$w_i = \frac{G_i}{\sum_{i=1}^n G_i}$$
(11)

 $w_i$  in the formula is the index weight calculated by entropy method.

Assuming that the weight values obtained by the subjective and objective weighting method are  $W_{1i}$  and  $W_{2i}$ , A and B represent the relative importance of the G1 method and the entropy method, respectively, A+B=1 and 0 < A, B < 1. Then the weight value of the subjective and objective weighting is:

$$W_i = AW_{1i} + BW_{2i} \tag{12}$$

## 4 importance of teaching evaluation indicators in Universities under the "Internet plus education" 4.1 A novel scoring function

The intuitionistic fuzzy cross-entropy<sup>[51]</sup> can use the interactive relationship between membership degree and non-membership degree to determine hesitation degree, so as to optimize the defect problem of scoring function construction when the information between membership degree, non-membership degree and hesitation degree is uncertain. This leads to the problem of secondary comparison when the membership degree and non-membership degree of the intuitionistic fuzzy set are the same<sup>[52]</sup>. Therefore, the research in this paper considers introducing the intuitionistic fuzzy cross-entropy into the exponential function to construct a novel scoring function.

Definition: Assuming any intuition  $A = \langle \mu_A(x), \theta_A(x), \pi_A(x) \rangle$ , the scoring function of the intuitionistic fuzzy set is:

$$S(A) = \frac{\exp\{\mu_A(x) - \theta_A(x) + H(x)I(x)\pi_A(x)\}}{1 + \pi_A^2(x)}$$
(13)

$$H(x) = \frac{H\left[\mu_A(x), \theta_A(x)\right] + H\left[\mu_A(x) + \theta_A(x)\right]}{2}$$
(14)

$$H\left[\mu_{A}(x),\theta_{A}(x)\right] = \mu_{A}(x)\frac{\mu_{A}(x)-\theta_{A}(x)}{\mu_{A}(x)+\theta_{A}(x)} + \left[1-\mu_{A}(x)\right]\frac{1-\mu_{A}(x)+\theta_{A}(x)}{1-\mu_{A}(x)-\theta_{A}(x)}$$
(15)

$$I(x) = \begin{cases} 1, & \mu_{A}(x) > \theta_{A}(x) \\ 0 & \mu_{A}(x) = \theta_{A}(x) \\ -1 & \mu_{A}(x) < \theta_{A}(x) \end{cases}$$
(16)

The novel scoring function uses the intuitionistic fuzzy cross-entropy to explain the relationship between hesitation degree, membership degree and non-membership degree in the original scoring function. The scoring function based on intuitionistic fuzzy cross-entropy improves the problem of secondary comparison resulting from the same membership degree and non-membership degree. Then if  $\mu_A(x) = \theta_A(x)$  appears in this scoring function, we have:

$$S(A) = \frac{\exp\{0\}}{1 + \pi_A^2(x)} = \frac{1}{1 + \pi_A^2(x)}$$
(17)

#### 4.2 Teaching evaluation index system of Universities under the "Internet plus education"

According to the principles of constructing the above teaching evaluation index system, we have constructed an evaluation index system of "Internet plus education" to art teaching through reading a large number of documents, conducting interviews, questionnaires and lectures in other art colleges, and in order to further ensure the scientific of the index system, China has been experts from Chinese universities and colleges. Front line teachers, university leaders and college students issued multiple rounds of questionnaires, and finally defined the teaching evaluation index system shown in **Table 2** below.

<b>Table.2</b> An evaluation index system of art teaching quality under Internet plus education					
Level I indicators (target level)	Secondary index (criterion level)	Level III indicators (scheme level)			
		Students' basic level of Art $Z_{111}$			
	Student performance $Y_{11}$	Students' class inquiry ability $Z_{112}$			
		Students' training intensity after $class Z_{113}$			
		Adequacy of teachers' preparation before $class_{Z_{121}}$			
Ouality evaluation of art teaching under	Teacher performance Y.	Teachers' class teaching $level_{Z_{122}}$			
Internet plus education $X_1$	1 - 12	Teachers' after-class counseling performance			
		Z <sub>123</sub>			
		Ease of media use and operation $Z_{131}$			
	Selection and use of media platform $Y_{13}$	The use of media conforms to the scene of art teaching $Z_{132}$			
		The choice of media use meets the needs of students $Z_{133}$			

According to the construction of the evaluation index system of art teaching under the Internet plus education, we will build the index hierarchy model as shown in **Figure 2** below:



Fig.2 Schematic diagram of hierarchy model

#### 5 Case analysis

The G1 method decision matrix is scored by experts. The reliability standard of experts is judged from five aspects: length of service, education, major, experience and professional title. The specific standard weight is shown in **Table 3** below. **Table.3** Expert scoring weight table

	Tublete	Expert seering weight table		
Factors	Weight r	Level	Value	S
		>30	0.8	
Seniority	3	15-30	0.6	
		<15	0.4	
		Doctor	0.8	
Education	2	Master	0.6	
		Bachelor	0.4	
	2	Law	0.8	
Major		Politics	0.6	
		Sociology	0.4	
<b>F</b>	2	Have research experience in art teaching	0.8	
Experience	2	No research experience in Art Teaching	0.4	
		Senior	0.8	
Professional title	1	Associate senior	0.6	
		Intermediate	0.4	

The formula for calculating expert credibility is:

$$R = \frac{\sum_{i=1}^{5} r_i s}{\sum_{i=1}^{5} r_i}$$

where R represents the reliability of experts.

In the research of the quality evaluation of art teaching in the context of "Internet plus education", we found 5 experts from China Institute of Social Study who ranked and graded the importance of the 9 indicators in the table 2. The basic information of the experts is shown in **Table 4**.

. .

	Iable.4 Basic information form of five evaluation experts									
No.	Seniority	Education	Major	Experience	Professional title					
1	18	Doctor	Other Pedagogy	No research experience in Art Teaching	Associate Professor					
2	10	Doctor	Art Pedagogy	Have research experience in art teaching	Lecture					
3	12	Doctor	Social politics	Have research experience in art teaching	Associate Professor					
4	20	Doctor	Other Pedagogy	Have research experience in art teaching	Professor					
5	8	Doctor	Other Pedagogy	No research experience in Art Teaching	Lecture					

According to the scoring and ranking of the importance of the nine indicators by experts, we combed the statistics of the intuitionistic fuzzy decision matrix scored by experts, as shown in **Table 5** below.

Table.5 Intuitionistic fuzzy	decision matrix for art	teaching quality evaluation	n in Colleges and Universities	S
indicio intertitotitoti i azz	accision maanni for are	teaching quanty evaluation	in in coneges and chivershies,	~

			5		81 5		8		
	$Z_{111}$	$Z_{_{112}}$	$Z_{_{113}}$	$Z_{121}$	$Z_{122}$	$Z_{123}$	$Z_{131}$	$Z_{132}$	$Z_{133}$
$Z_{111}$	(0.5,0.5,0.0)	(0.7,0.2,0.1)	(0.6,0.3,0.1)	(0.5,0.4,0.1)	(0.6,0.2,0.2)	(0.6,0.1,0.3)	(0.5,0.3,0.2)	(0.6,0.1,0.3)	(0.4,0.4,0.2)
$Z_{_{112}}$	(0.7,0.2,0.1)	(0.5, 0.5, 0.0)	(0.4,0.4,0.2)	(0.5,0.2,0.3)	(0.4,0.3,0.3)	(0.5,0.2,0.3)	(0.7,0.1,0.2)	(0.7,0.1,0.2)	(0.6,0.3,0.1)
$Z_{113}$	(0.4,0.3,0.3)	(0.5,0.2,0.3)	(0.5, 0.5, 0.0)	(0.4,0.2,0.4)	(0.5,0.2,0.3)	(0.8,0.1,0.1)	(0.7,0.2,0.1)	(0.5,0.4,0.1)	(0.5,0.4,0.1)
$Z_{121}$	(0.2,0.7,0.1)	(0.2, 0.6, 0.2)	(0.2,0.7,0.1)	(0.5,0.5,0.0)	(0.8,0.1,0.1)	(0.8,0.1,0.1)	(0.6, 0.4, 0.0)	(0.6, 0.4, 0.0)	(0.7,0.3,0.0)
$Z_{122}$	(0.8,0.2,0.0)	(0.4,0.3,0.3)	(0.5,0.1,0.4)	(0.4,0.3,0.3)	(0.5,0.5,0.0)	(0.4,0.5,0.1)	(0.8,0.2,0.0)	(0.7,0.1,0.2)	(0.5,0.4,0.1)
$Z_{123}$	(0.7,0.1,0.2)	(0.5,0.2,0.3)	(0.6, 0.4, 0.0)	(0.6,0.2,0.2)	(0.8,0.2,0.0)	(0.5, 0.5, 0.0)	(0.7,0.2,0.1)	(0.3,0.4,0.3)	(0.8,0.1,0.1)
$Z_{131}$	(0.7,0.3,0.0)	(0.8,0.1,0.1)	(0.6,0.3,0.1)	(0.9,0.1,0.0)	(0.3,0.7,0.0)	(0.7,0.2,0.1)	(0.5,0.5,0.0)	(0.3,0.5,0.2)	(0.3,0.5,0.2)
$Z_{132}$	(0.6,0.3,0.1)	(0.8,0.1,0.1)	(0.5,0.4,0.1)	(0.5,0.3,0.2)	(0.7,0.3,0.0)	(0.5,0.3,0.2)	(0.9,0.1,0.0)	(0.5,0.5,0.0)	(0.5,0.5,0.0)
$Z_{133}$	(0.3,0.6,0.1)	(0.4,0.5,0.1)	(0.2,0.6,0.2)	(0.8,0.1,0.1)	(0.9,0.1,0.0)	(0.6,0.3,0.1)	(0.5,0.3,0.2)	(0.7,0.2,0.1)	(0.5, 0.5, 0.0)

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(18)

Step 1: according to equation (13), the intuitionistic fuzzy decision matrix in **Table 5** can be transformed into a real matrix based on the new scoring function to further calculate the index importance of art teaching quality evaluation in Colleges and universities. The real matrix is recorded as  $D = (D_{ij})_{msin}$ 

$$D = \left(D_{ij}\right)_{m \times x} = \begin{cases} 0.735 & 1.226 & 0.986 & 1.234 & 1.098 & 1.657 & 1.546 & 1.786 & 2.567 \\ 1.268 & 1.124 & 0.345 & 1.267 & 1.121 & 0.678 & 1.789 & 1.567 & 2.675 \\ 0.642 & 1.198 & 0.657 & 1.789 & 0.567 & 1.106 & 2.234 & 1.235 & 0.999 \\ 1.688 & 3.068 & 0.953 & 1.902 & 0.679 & 1.204 & 2.567 & 0.694 & 1.567 \\ 0.992 & 0.998 & 0.486 & 1.923 & 1.235 & 2.222 & 2.765 & 1.689 & 1.643 \\ 0.235 & 3.556 & 2.456 & 1.231 & 1.953 & 2.395 & 2.103 & 0.694 & 1.567 \\ 2.456 & 2.454 & 1.245 & 2.456 & 2.067 & 2.432 & 2.041 & 1.694 & 1.754 \\ 0.981 & 0.567 & 1.654 & 0.567 & 0.694 & 1.029 & 0.776 & 0.875 & 0.979 \\ 2.565 & 0.465 & 1.903 & 0.668 & 2.456 & 0.532 & 0.909 & 0.532 & 1.234 \end{cases}$$

Step 2: according to the subjective and objective weighting results of equation (12), the weight values of 9 indicators are:

 $W_{111} = 0.122, W_{112} = 0.103, W_{113} = 0.068, W_{121} = 0.098, W_{122} = 0.102, W_{123} = 0.146, W_{131} = 0.078, W_{132} = 0.235, W_{133} = 0.048$ 

The weights of the above nine indicators meet the constraint condition that the sum of weights is 1.

Step 3: weighted product the 9 index weight values obtained in step 2 with the index importance real matrix calculated in step 1 to obtain the index importance ranking weighting result matrix, as shown below:

$$M = \left(D_{ij}\right)_{m \times n} \cdot \begin{bmatrix} W_{111} \\ W_{112} \\ W_{113} \\ W_{121} \\ W_{122} \\ W_{133} \\ W_{131} \\ W_{132} \\ W_{133} \\ W_{131} \\ W_{132} \\ W_{133} \\ W_{131} \\ W_{132} \\ W_{133} \end{bmatrix} = \begin{cases} 0.735 & 1.226 & 0.986 & 1.234 & 1.098 & 1.657 & 1.546 & 1.786 & 2.567 \\ 1.268 & 1.124 & 0.345 & 1.267 & 1.121 & 0.678 & 1.789 & 1.567 & 2.675 \\ 0.642 & 1.198 & 0.657 & 1.789 & 0.567 & 1.106 & 2.234 & 1.235 & 0.999 \\ 1.688 & 3.068 & 0.953 & 1.902 & 0.679 & 1.204 & 2.567 & 0.694 & 1.567 \\ 0.992 & 0.998 & 0.486 & 1.923 & 1.235 & 2.222 & 2.765 & 1.689 & 1.643 \\ 0.235 & 3.556 & 2.456 & 1.231 & 1.953 & 2.395 & 2.103 & 0.694 & 1.567 \\ 0.456 & 2.456 & 2.454 & 1.245 & 2.456 & 2.067 & 2.432 & 2.041 & 1.694 & 1.754 \\ 0.981 & 0.567 & 1.654 & 0.567 & 0.694 & 1.029 & 0.776 & 0.875 & 0.979 \\ 2.565 & 0.465 & 1.903 & 0.668 & 2.456 & 0.532 & 0.909 & 0.532 & 1.234 \end{cases} \begin{bmatrix} 0.122 \\ 0.103 \\ 0.068 \\ 0.981 \\ 0.235 \\ 0.942 \\ 1.756 \end{bmatrix}$$

According to the final index importance ranking result matrix, it can be seen that the importance ranking results of the nine indexes are as follows:

The choice of media use meets the needs of students  $Z_{133}$  > the adequacy of teachers' preparation before class  $Z_{121}$  > students' class inquiry ability  $Z_{112}$  > students' basic art level  $Z_{111}$  > teachers' class teaching level  $Z_{122}$  > teachers' after-class counseling performance  $Z_{123}$  > media use meets the art teaching scene  $Z_{132}$  > the difficulty of media use and operation  $Z_{131}$  > the strength of students' after-school training  $Z_{113}$ .

# 6 The reform strategies and suggestions of "Internet plus education" in the art teaching in Colleges and Universities under the background of COVID-19

Through the fifth part of our research, we have got the results of ranking the indicators of "Internet plus education" in China's art teaching. The top three indicators are: media choice, students' needs, teachers' pre class preparation and students' classroom inquiry ability. Therefore, it can be explained that "Internet plus" has changed the emphasis of art teaching. In the past, the quality of art teaching has been weakened by the students' core and teacher's teaching level. According to our research, in the art teaching of China's universities, with the Internet plus education popularization, art teachers should pay attention to the selection and use of media platforms based on students' interests and needs, and be familiar with all kinds of media platforms to ensure the efficiency and creativity of preparing lessons before class. Besides, from the perspective of students, students should attach importance to participating in classroom initiatives. If the media platform meets the needs of students' interests, students will improve classroom participation. Of course, the basic level of students can not be ignored.

From the current curriculum of colleges and universities offering digital media art, the main courses mainly include digital image processing, web design, multimedia technology, interactive design, animation design, virtual reality, art design, music performance and so on. Influenced by the traditional education mode in Colleges and universities, students majoring in digital media art still accept the "education mode of continuous repetition and serious imitation", which is lack of speculation. One is. In order to meet the development needs of information society, we need experts in digital media art design education to explore interactive teaching between teachers and students in the Internet plus action plan based on the content of digital media art courses, and integrate online and offline teaching mode with information communication technology and Internet platform. How to infiltrate the idea of "Internet plus education" into digital media art teaching, we can start from the following aspects:

First, teachers' control of advanced technology is the premise. From the perspective of the current distribution of the staff structure of teachers majoring in digital media art, mainly middle-aged and young teachers under the age of 40, the younger teacher team generally has a high acceptance of the intersection of information technology, and has the educational background of the intersection of art and information technology. The professional development of digital media art is fast, relying on the rapid development of digitization, Many teachers have the sensitivity and application ability of relevant technology, which provides the precondition for the integration of "Internet plus education" and art teaching.

Second, the training policy of innovative talents is the guidance. Combining Internet plus with digital media art teaching needs to cultivate students' thinking and innovative thinking in the course teaching. The traditional digital art teaching policy is mainly to cultivate technical talents and teach students how to learn to use software. Students lack thinking. After learning a course, they often realize the transformation of a certain software from not to meeting, but are relatively lack of flexible application and innovation. Therefore, the cultivation of art talents under the "Internet plus education" needs to be guided by the quality of innovative talents. According to the training characteristics of "innovative" talents, it is necessary to cultivate students' curiosity and knowledge desire and cultivate their self exploration ability.

Third, we should change the problems and problems in teaching, and make Internet plus education a popular teaching mode for students, stimulate students' enthusiasm and initiative in learning, and at the same time, improve students' learning level. However, due to the lack of hardware and quality of teaching hardware, it is difficult to implement the "Internet plus" art teaching in practice. However, this study can provide guidance for relevant decision-making departments, especially the teaching and administrative departments, and provide some reference for improving the teaching environment and leading the application of new technologies.

### 7. Why are we doing this study?

Classroom teaching is the main way to realize talent development in Chinese colleges and universities, and it is also the main approach of knowledge transmission in colleges and universities. With the integration of "Internet +" and education, the trend of intelligent and multimedia classroom teaching in colleges and universities is becoming more and more obvious. The teaching modes such as "MOOCs", "micro course" and "flipped classroom" have also begun to subvert the traditional classroom teaching forms and force colleges and universities to reform with unstoppable momentum. However, for many local colleges and universities in China, the classroom teaching form is still mainly telling something, and the effectiveness of teaching is insufficient, which affects the quality of talent development. "Internet+education" changed the traditional college classroom teaching form, teachers are not only the knowledge imparting and indoctrination, also designers and guides, not only need to interact with students at any time, answer questions, and need to the whole teaching process of import, supervision and evaluation, form the extension of independent learning after class, teachers answer questions summarizes the new teaching mode. The teaching form is a challenge to change local teachers' education concepts, ideology and adaptability.

"Internet + education" how to put forward a suitable teaching quality evaluation method is the purpose of this study, not only can not future "Internet + education" widely used to provide technical support, but also can provide theoretical guidance for innovative education concepts, so the research conforms to the trend of the international and domestic education reform orientation, and it has important research value and significance.

## 8. Conclusion

Through this study, we have obtained the following specific conclusions:

(1) This paper proposes a fuzzy evaluation method that combines the subjective and objective empowerment, which aims to improve the intuitive fuzzy set evaluation method. First, based on analyzing the defects of intuitive fuzzy cross entropy, we put forward the subjective empowerment G1 method and the objective empowerment method.

(2) We not only realized the improvement and innovation of theoretical method, but also applied it to the quality evaluation of Chinese colleges and universities, and we constructed the index system and hierarchy model, the index system consists of 1 level index, three second-class indexes and 9 third-class indexes, researchers applied the improved intuition fuzzy set evaluation method to the calculation of 9 indicators, and get the index importance ranking results. The results show that media application can meet students' needs. It has become an important factor under the background of "Internet+ education".

(3) This paper not only realizes the theory method improvement, practice case innovation, but also applies the real theory, case, conclusion to the actual countermeasures and suggestions through our theoretical analysis and case results analysis. Based on the international and domestic "Internet+education" teaching form, especially university art teaching, the study provides policy opinion and suggestions, provide relevant factors to educational departments and put forward three different reform measures to meet the needs of future education development.

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