
Research on Evaluation Index System of Blended Teaching

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Abstract:

To scientifically evaluate the implementation effect of blended teaching, it is necessary to establish an evaluation index system that conforms to the teaching concept of blended learning. This study takes teachers, students and supervisors as the evaluation subjects, constructs a three in one blended teaching index system framework of teachers' teaching, student's performance and classroom effect detection. Through the questionnaire survey on the system by relevant experts, teachers and supervisors, analytic hierarchy process (AHP) is used to assign weights to the three dimensions of evaluation indicators, and the university PE is taken as an example. It lays a foundation for the construction of a complete blended teaching evaluation system in colleges and universities.

Keywords: Blended learning, Teaching evaluation, Analytic hierarchy process, Index system.

I. INTRODUCTION

A large number of studies on learning process and teaching methods have shown that blended teaching has become an innovative learning mode and effective learning mode universally recognized and respected by all countries in the world [1-4]. As for the definition of flipping, Daphne miner, et al. Defined the core elements of blended teaching in concise language: research object (i.e., scientific content); students participation mode; students enthusiasm, thinking or participation in learning activities. According to Hattie, a professor of pedagogy at the University of Melbourne, blended teaching is a challenging learning method, which requires students to observe, question, explain, design and complete experiments on certain phenomena, prove or refute their theories with data and draw conclusions from them. In addition, Barber believes that scientific inquiry at this stage mainly refers to students summarizing or making answers to questions through critical thinking and scientific reasoning on the basis of investigation and research [5-7].

Back to China's colleges and universities, with the new round of higher education teaching reform, it has begun to actively promote heuristic, discussion and participatory teaching from the aspects of talent training mode, curriculum system, teaching content and teaching methods, so as to improve students' learning ability, practical ability and innovation ability through the innovation of methods and modes. Under such a background, it is undoubtedly of great significance to actively carry out blended teaching in Colleges and universities to explore the academic theme, the subjectivity of inquiry activities, the practicality of inquiry process and the innovation of inquiry results. However, a basic fact is that although there are many theoretical studies on blended teaching in China's higher education, the practical research is still relatively weak. The vast majority of colleges and universities in the development of curriculum teaching, although the subject of frontier knowledge has been explored and guided, but the students' inquiry skills training is not enough, blended teaching method has not reached the point of using freely. On the basis of this, how to focus on the blended teaching and how to help teachers understand and master the blended teaching methods need scientific evaluation means and evaluation mechanism. Therefore, it is of great significance to construct the evaluation system of blended teaching in Colleges and universities.

II. THE FRAMEWORK OF BLENDED TEACHING INDEX SYSTEM

Classroom is the main place of coupling between teachers and students, and between students. Teachers guide students to learn by creating problem situations. Due to the various and complex factors that affect teachers' and students' cognition and identification of blended learning, in view of the previous research of scholars, this paper mainly studies the teaching index system of college PE teaching under the blended learning, including teaching activities, students' performance and teaching effect evaluation. Through the questionnaire survey of relevant experts, teachers, supervisors and so on and many rounds of consultation, the specific indicators covered by the evaluation system are constantly revised and improved, and a three in one blended teaching evaluation system framework of teaching, students' performance and classroom effect detection" is constructed. According to the relevant requirements of Delphi method, from the three dimensions of teaching, performance and effect detection, the evaluation factors of each index are calculated respectively, and a quantifiable evaluation scale is formed.

III. TEACHERS TEACHING INDEX DESIGN.

Blended teaching is carried out on the basis of teaching. In the classroom, students' blended learning ability presents hierarchy, diversification and personalization. Therefore, in

the implementation process of blended teaching, teachers should embody the characteristics of openness, thematic, and cooperation. According to the teaching objectives and teaching contents, students' interest in learning and creation should be put at the top of teaching activities. The blended teaching, which starts from problems, is based on practice and embodies creation, is implemented into the students teaching process as a prominent theme. The exercises related to the given contents and with certain difficulties are carefully designed. By creating problem situations and focusing on students' suggestions, a good learning atmosphere is created, which provides sufficient opportunities for students to express freely, question, explore, discuss and cooperate will, and then produce a positive effect of inquiry. See TABLE I for the design of teachers teaching indicators.

TABLE I. Evaluation index system of teachers Teaching

Primary indicators	Secondary indicators	Third level index
Teachers Teaching	Teaching content A ₁	Contact with practice and trace the frontier problem B ₁ of PE
		Cultivating students systematic thinking B ₂
		Introducing the latest choreography B ₃
		Traditional theory B ₄
	Teaching method A ₂	Using modern information technology to assist blended teaching B ₅
		Students refer to relevant materials B ₆ before class
		Encourage students to express, question and discuss B ₇ freely
		Set up study group and carry out group study B ₈
		Open training B ₉
		Fully communicate with students, pay attention to collect students opinions, and continuously improve teaching B ₁₀
	Teaching	Create problem situation and create interaction between teachers

	effect A_3	and students
		Inspire students to think about B_{12} through teacher guidance
		Diversified assessment methods, comprehensive assessment of students knowledge and ability B_{13}
		After blended learning, it is easier for students to form the knowledge construction of PE theory B_{14}
		Students self-study ability, cooperation and communication ability have been improved

IV. DESIGN OF STUDENT'S PERFORMANCE INDICATORS.

Students are the main body of blended teaching. Under the guidance of teachers and based on the basis, a number of learning groups are set up to carry out relevant research, data review, study discussion, report writing, teachers and students comments, scheme improvement and other activities, so as to enable students to flip through the interaction between teachers and students, find problems, practice operation, team cooperation and so on in the discipline field or real life situation Process experience, master the views, methods and means of dealing with related topics, better complete the construction of knowledge, and form a more systematic knowledge system. The design of students performance indicators is shown in TABLE II.

TABLE II. Student teaching evaluation index system

Primary indicators	Secondary indicators	Third level index
		Interest and enthusiasm for blended learning B_1
	Learning attitude A_1	Actively participate in group discussion B_2
		Correct attitude, take the initiative to complete B_3

Students performance		B ₄ has the initiative to solve problems
	Cooperative spirit	Obey the division of labor in groups, unite and cooperate, and help others B ₅
	A ₂	Be able to listen to other people s reasonable suggestions and actively express personal opinions B ₆
		Strong communication skills, through cooperation, can jointly complete the inquiry project B ₇
	Learning process A ₃	Mastery of theoretical knowledge B ₈
		Wrong action correction B ₉
		Correct use of various learning materials B ₁₀
		The practical ability of B ₁₁ was improved significantly
		The thinking ability was significantly improved B ₁₂

V. EXPLORE THE DESIGN OF EFFECT DETECTION INDEX.

The evaluation of the effectiveness of blended teaching is mainly reflected in two basic aspects: the independent construction of students; knowledge and the generation of teaching process. The design of indicators for the effect of blended teaching is shown in TABLE III.

TABLE III. Evaluation index system of exploration effect detection

Primary indicators	Secondary indicators	Third level index
	Scientific A ₁	Outstanding content and full expression B ₁
		Distinct teaching theme B ₂
		Strong operability B ₃

Teaching effect test		Reflect academic B ₄
	Innovative A ₂	Topic selection direction novel B ₅
		Clear research ideas B ₆
		The theme design is reasonable and the structure is novel B ₇
		The content embodies theoretical value and practical value B ₈
	Systematic A ₃	Teaching main line at a glance B ₉
		The overall frame structure is reasonable and attractive

VI. MODEL CONSTRUCTION AND METHOD

In this paper, the analytic hierarchy process (AHP) is used to carry out the metrological test.

6.1 Establish the Hierarchical Structure Model of Each Level.

According to the previous index system framework, the hierarchical structure model of AHP is composed of target layer, criterion layer and index layer. Taking the teaching evaluation of teachers as an example, the target level contains a factor; the criterion layer is the intermediate link, covering three influencing factors: teaching content, teaching method and teaching effect; the index layer is also called the evaluation object layer, which contains 15 indicators. Similarly, the hierarchical structure model of students performance and teaching effect detection can be constructed.

6.2 Construct Pairwise Comparison Judgment Matrix.

This paper adopts the scale 1-9 proposed by Saaty, that is, according to the degree of importance, scale 1 is of equal importance compared with two elements, scale 3 is slightly more important than the latter, and so on, the maximum scale value of 9 means that the former is extremely important than the latter, To determine the specific value in the judgment matrix.

6.3 The Sum Product Method is Used to Determine the Weight Coefficient of Each Judgment Matrix.

According to the judgment matrix to find its maximum eigenvalue λ_{max} and the corresponding normalized eigenvectors $W = \{w_1, w_2, \dots, w_n\}$ And W satisfies $(A_k - B)W = \lambda_{max} W$. After normalization, the weight of the relative importance of the layer to a factor in the upper layer can be obtained. And the algorithm of W is as follows:

Calculate the product of each element in each row of the judgment matrix $m_i = \prod_{j=1}^n a_{ij} = 1, 2, \dots, n$ The n -th root of $M_i = \sqrt[n]{m_i}$ And then, for the vector $W = \{w_1, w_2, \dots, w_n\}$ Normalization was performed $w_i = \bar{w}_i / \sum_{i=1}^n \bar{w}_i$, finally $W = \{w_1, w_2, \dots, w_n\}$ Is the calculated result vector:

Calculating the maximum eigenvalue of a matrix $\lambda_{max}, \lambda_{max} = (1/n) \sum_{i=1}^n (AW)_i / w_i$ For any $i = 1, 2, \dots, n$. $(AW)_i$ is the i -th element of vector aw .

6.4 Consistency Test.

The consistency test indexes CI and RI are established to judge the degree of matrix deviation from consistency.

Calculate consistency index $CI = (\lambda_{max} - n) / (n - 1)$, n is the order of the judgment matrix, λ_{max} It is the largest eigenvalue of the judgment matrix; the relative consistency index is calculated $CR = CI / RI$ Where, RI The consistency of each index is the corresponding matrix RI It can be obtained by looking up the table. Usually when , the consistency test passed, when CR is more than 0.1, the judgment matrix needs to be reconstructed.

VII. WEIGHT CALCULATION AND RESULT ANALYSIS.

According to the analytic hierarchy process (AHP) calculation principle, in order to get the pairwise comparison matrix, the corresponding questionnaire was designed. Taking Anyang Preschool Teachers College as an example, 60 questionnaires were distributed and 45 questionnaires were recovered. The respondents were teachers, leaders of teaching units and experts from the same profession. Through the summary and statistics of the questionnaire, the comprehensive judgment matrix of the expert group is formed. According to the steps of analytic hierarchy process, weight calculation and measurement test are carried out by expert choice decision software.

7.1 The Weight of Teachers Teaching Indicators.

The criteria layer of the teacher s teaching index system consists of three aspects. There are 15 items in the indicator layer. Finally, the judgment matrix after expert consultation is obtained. Take the matrix of criterion layer A_1 and that of criterion layer A_2 as examples

$$A = \begin{matrix} & A_1 & A_2 & A_3 \\ A_1 & 1 & 3 & 1/3 \\ A_2 & 1/3 & 1 & 1/5 \\ A_3 & 3 & 5 & 1 \end{matrix}$$

$$A_1 = \begin{matrix} & B_1 & B_2 & B_3 & B_4 \\ B_1 & 1 & 3 & 1/3 & 1/5 \\ B_2 & 1/3 & 1 & 1/3 & 1/5 \\ B_3 & 3 & 1/3 & 1 & 1/3 \\ B_4 & 5 & 5 & 3 & 1 \end{matrix}$$

Furthermore, the consistency test of judgment matrix is carried out, and the consistency test index is established CI and RI To judge the degree of matrix deviation from consistency.

Calculate consistency index $CI = (\lambda_{max} - n) / (n - 1)$, n is the order of the judgment matrix, λ_{max} In order to judge the maximum characteristic flow interaction of the matrix, timely feedback, the "teachable moment" is transformed into the "learnable moment" of students; in the index layer of teaching effect, the weight of B_{13} is $\lambda_{13} = 0.479$ According to the teaching objectives and contents, teachers should set up some open course assignments related to the topic of inquiry, and comprehensively evaluate the knowledge and ability of students. In the criterion layer, the weight of teaching effect a is 0.637, more than half of which indicates that in teaching evaluation, teachers should take students as the center, carry out situational teaching, stimulate their thinking, interaction, cooperation and research, and truly form the construction of the knowledge they have learned.

TABLE IV. Weight of teachers teaching evaluation index

Target layer	Criterion layer	Weight of criterion layer	Index layer	Weight ranking of each level	Total weight ranking
Teachers Teaching	Teaching content A_1	0.258	Contact with practice and trace the frontier problem B_1 of PE	0.129	0.033
			Cultivating students	0.074	0.019

			systematic thinking B ₂		
			Introducing the latest choreography B ₃	0.248	0.064
			Traditional theory B ₄	0.549	0.142
	Teaching method A ₂	0.105	Using modern information technology to assist blended teaching B ₅	0.029	0.003
			Students refer to relevant materials B ₆ before class	0.103	0.011
			Encourage students to express, question and discuss B ₇ freely	0.182	0.019
			Set up study group and carry out group study B ₈	0.242	0.025
			Open training B ₉	0.065	0.007
			Fully communicate with students, pay attention to collect students opinions, and continuously improve teaching B ₁₀	0.379	0.040
	Teaching effect A ₃	0.637	Create problem situation and create interaction between teachers and students	0.046	0.029
			Inspire students to think about B ₁₂ through teacher guidance	0.082	0.053
			Diversified assessment methods, comprehensive assessment of students knowledge and ability B ₁₃	0.479	0.305

			After blended learning, it is easier for students to form the knowledge construction of PE theory B ₁₄	0.148	0.094
			Students self-study ability, cooperation and communication ability have been improved	0.245	0.156

7.2 The Weight of Students Performance Indicators.

Similarly, we can get the weight of students performance indicators. As can be seen from table 5, the weight of B in the indicator layer of learning attitude $\lambda_3 = 0.505$ Only when we treat it correctly, can we stimulate students enthusiasm for inquiry and become the main body of inquiry. In the indicator layer of the spirit of cooperation, the weight of B₆ is $\lambda_6 = 0.637$ Students blended learning ability is diversified and personalized. Different people can analyze problems from different angles and levels. Therefore, it is particularly important to accept suggestions from others to correct their improper views. In the index layer of the inquiry process, the weight of B₈ $\lambda_8 = 0.449$ In the blended teaching, students pay more attention to the scientificity and feasibility of teaching themes. Therefore, teachers should set up a creation environment of suspense, conflict, contradiction and confusion on a certain topic, so as to attract students to actively study, explore and discover, so as to produce a kind of best learning orientation. In addition, the weight of inquiry process a in the criterion layer is 0.540, more than half of which indicates that students pay attention to the learning process in the blended teaching learning process, and their innovative consciousness and thinking are further improved, thus further enriching the connotation of blended teaching.

TABLE V. Weight of students performance evaluation index

Target layer	Criterion layer	Weight of criterion layer	Index layer	Weight ranking of each level	Total weight ranking

Student s performance	Learning attitude A ₁	0.297	Interest and enthusiasm for blended learning B ₁	0.143	0.042
			Actively participate in group discussion B ₂	0.064	0.019
			Correct attitude, take the initiative to complete B ₃	0.505	0.150
			B ₄ has the initiative to solve problems	0.288	0.058
	Cooperative spirit A ₂	0.163	ObeY the division of labor in groups, unite and cooperate, and help others B ₅	0.105	0.017
			Be able to listen to other people s reasonable suggestions and actively express personal opinions B ₆	0.637	0.104
			Strong communication skills, through cooperation, can jointly complete the inquiry project B ₇	0.258	0.042
	Learning process A ₃	0.540	Mastery of theoretical knowledge B ₈	0.449	0.242
			Wrong action correction B ₉	0.156	0.084
			Correct use of various learning materials B ₁₀	0.245	0.132
			The practical ability of B ₁₁ was improved significantly	0.058	0.031
			The thinking ability	0.092	0.049

			was significantly improved B ₁₂		
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7.3 Explore the Index Weight of Effect Detection.

In the same way, we can get the index weight of inquiry effect detection. It can be seen from TABLE VI. that the weight of B is in the scientific index layer $\lambda_2 = 0.647$ In the course assignment design, we should focus on the construction of research topics similar to the real situation, and the determination of the research topics should be closely related to the teachers teaching content; in the innovative index layer, the weight of B7 and B8 should λ_7, λ_8 Both are 0.394, indicating that these two indicators are equally important. Therefore, to evaluate the innovation of teaching effect, the design of learning theme and the presentation of content should be based on the combination of theory and practice. The structural design forms can be diverse but must be reasonable, and reflect strong application value.

TABLE VI. Weight of teaching effect evaluation index

Target layer	Criterion layer	Weight of criterion layer	Index layer	Weight ranking of each level	Total weight ranking
Teaching effect test	Scientific A ₁	0.249	Outstanding content and full expression B ₁	0.059	0.015
			Distinct teaching theme B ₂	0.647	0.161
			Strong operability B ₃	0.103	0.026
			Reflect academic B ₄	0.191	0.048
	Innovative A ₂	0.594	Topic selection direction novel B ₅	0.075	0.045
			Clear research ideas B ₆	0.137	0.082

			The theme design is reasonable and the structure is novel B ₇	0.394	0.234
			The content embodies theoretical value and practical value B ₈	0.394	0.234
	Systematic A ₃	0.157	Teaching main line at a glance B ₉	0.750	0.118
			The overall frame structure is reasonable and attractive	0.250	0.039

$\lambda_9 = 0.705$, which indicates that the research content must conform to certain logic and be carried out according to a main line, which requires students to conduct in-depth and detailed investigation and master rich and detailed data, and finally promote the achievement of learning objectives. In addition, the weight of innovation A₂ in the criterion layer is 0.540, which is more than half. The theme design should be scientific and reasonable, and the research content should reflect high theoretical value and practical value, which shows the importance of innovation.

VIII. DISCUSSION

In this paper, through the construction of "teachers teaching, students performance, teaching effect detection" three in one blended teaching evaluation system framework, from the teaching, performance, effect detection three dimensions of the weight calculation of each index influence factor, formed a set of relatively objective evaluation scale. It is found that compared with other indicators, the teaching effect of teachers teaching, the learning process of students performance and the innovation evaluation in the effect detection are particularly important, which undoubtedly points out the direction of the focus of blended teaching. First of all, the blended teaching should emphasize the problem-based and the students independent inquiry to acquire knowledge and solve the problems. Teachers should highlight the dominant position of students, guide students to explore actively, and ultimately achieve the goal of students autonomous learning. Secondly, in the process of blended learning, students can form relatively complete inquiry thinking and ability around the problem situation created by teachers, through active discovery of problems, communication and discussion, experimental practice, cooperation and other links and stages of training. In addition, with the urgent needs of society for innovative talents, colleges and universities pay more and more attention to the cultivation of students

innovative ability. Blended teaching is regarded as an innovative learning mode and effective learning mode, which is highly consistent with the training objectives of innovative talents in Colleges and universities. Therefore, advocating blended learning in college education environment can provide experience and motivation for students to acquire problem-solving ability and lifelong learning skills, and has a positive role in promoting the growth of innovative talents.

The evaluation of blended teaching in Colleges and universities is a more complex work. This paper uses AHP method to construct the core evaluation index system and weight, which is based on the university PE teaching. Different disciplines and different learning backgrounds will also have different indicators covered by this evaluation system. Therefore, the establishment of a perfect blended teaching evaluation system needs to be specific. In the process of practice, continuous optimization is also the direction of follow-up research.

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