

## Intelligent Evaluation Method of MOOC Learning Efficiency Based on Kirkpatrick's Model

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### Abstract

In view of the poor evaluation effect of MOOC learning efficiency, this study proposes an intelligent evaluation method of MOOC learning efficiency based on Kirkpatrick's model. Firstly, Kirkpatrick's model is used to screen the evaluation indexes of MOOC learning efficiency, so as to construct the intelligent evaluation system of teaching-learning efficiency. Then optimize the intelligent evaluation steps of teaching efficiency. The experimental results show that this method has high practicability and accuracy in practical application, and can fully meet the research requirements.

**Keywords:** Kirkpatrick's model; MOOC ; Index system; Efficiency evaluation

### Introduction

With the development of economic globalization, Hyundai faces more and more fierce market competition and personalized needs of customers. Only through continuous training can competitiveness be improved. Therefore, a lot of money, time and manpower have been invested in training. The question is whether training can effectively improve the quality and work efficiency of employees and achieve the expected results. This economic input-output analysis must be carefully considered [1].

It is important content in learning theory to measure the learning effect of individuals based on Kirkpatrick's model. MOOC education has the characteristics of adult education and vocational education, and has its own uniqueness in teaching objects, teaching objectives, teaching methods, teaching organization, and evaluation. With the gradual expansion of education in China, how constructing a course learning effect evaluation mechanism that conforms to the characteristics of students is of great value to ensure the quality of teaching and improve the social reputation of educational programs. Obviously, the intelligent assessment of MOOC learning efficiency is an important measure and means to test the effect and quality of training, but it is also the most important and difficult link in the training cycle [2].

At present, the intelligent evaluation of learning efficiency has become the bottleneck restricting the continuous improvement of education and training levels. There are many reasons for this situation: first, the evaluation may be affected by various variables and some factors that are difficult to quantify; Second, the evaluation may be affected by the students' trust in teachers; Third, the sensitivity of teachers' response to students and the political factors of the organization will affect the implementation of training evaluation to varying degrees.

In view of the above problems, this study is guided by the Kirkpatrick's four-level evaluation model, and establishes a set of evaluation index system to meet the needs of training evaluation through a comprehensive and systematic analysis of the training management process, so as to promote scientization and standardization of training evaluation and improve the quality and efficiency of training.

## Intelligent evaluation method of MOOC learning efficiency

### Collection of MOOC Learning Efficiency

Kirkpatrick takes the trainees as the object of evaluation. According to the depth and difficulty of evaluation, the training effect is divided into four progressive levels, namely reaction level, learning level, behavior level and result level [3]. The training evaluation model starts from 2. The most representative is the Kirkpatrick's four-level evaluation model (see table). Level evaluation (response level evaluation) refers to the trainees' views on the training project, including learning materials, teachers, teaching methods, content, environment and organization. Secondary assessment (learning level assessment) is the most common and commonly used parity method at present. It measures students' mastery of knowledge and skills. The 3<sup>rd</sup> level evaluation (behavior level evaluation) occurs after the training project. The superior, colleagues, subordinates or customers observe whether the trainees' behaviors are different before and after the training, and whether they have applied the knowledge learned in the training to improve their work performance. Level 4 assessment rises to the height of the organization, that is, whether the organization operates better because of training can be measured by some indicators.

Based on this, the structure of Kirkpatrick's four-level training evaluation model is analyzed, as shown in Table 1.

<i>Evaluation level</i>	<i>Primary coverage</i>	<i>Assessable issues</i>	<i>Evaluation method</i>
Level 1 assessment: reaction layer	Observe participants' reaction	Did the trainees like the training course? Is the course useful to you; What's your opinion on teachers and training facilities;	Questionnaire, questionnaire and interview
Level 2 assessment: learning level	Check learning results	What did the trainees learn from the training program; How much did the trainees improve their knowledge and skills before and after the training?	Questionnaire, written examination, case study
Level 3 assessment: behavioral level	Measure performance before and after training	Has the student's behavior changed? Can the trainees use the training knowledge in their work?	360 performance appraisal, testing and observation
Level 4 evaluation: result level	Measuring changes in the company's operating performance	Is the impact of behavior change on the organization positive?	Investigate the accident rate, production efficiency and economic benefits

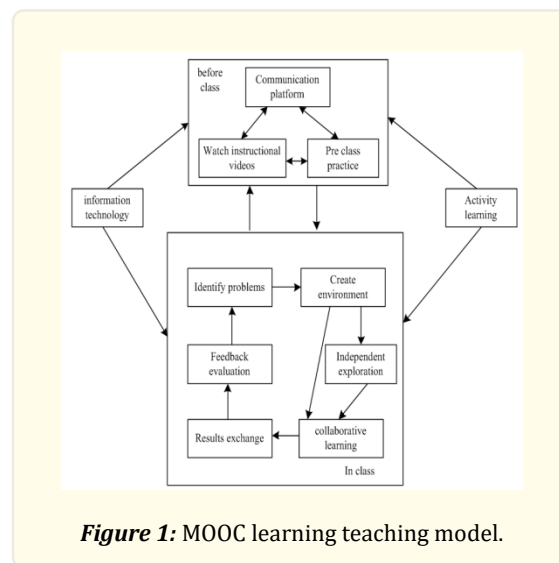
**Table 1:** Kirkpatrick's four-level training evaluation model.

Kirkpatrick's training evaluation model has been widely recognized in the West and has certain technological advancement [4]. However, this model focuses on qualitative research on training evaluation, and has great limitations in training practice.

In order to solve this problem, this paper is guided by the four-level evaluation model of Koch, combined with the implementation and management process of the mid-level management personnel training program. Based on the needs of the trainees, using scientific theories and systematic analysis methods, the analysis and research are carried out layer by layer at four levels: layer, learning layer, behavior layer and result layer to determine the corresponding evaluation methods and evaluation indicators. For the design of information technology teaching reform in the context of the MOOCs, it is necessary to activate the MOOC perspective, so that MOOCs play a leading role in teaching reform [5]. The content is introduced into the teaching curriculum, the use of large-scale open online

courses to integrate educational resources, improve the professional quality of teachers, adjust teaching methods, and carry out the MOOC teaching activities.

The design of information technology teaching reform still focuses on Teachers' teaching. Under the active guidance of teachers, students' perspective of admiring classes is activated [6]. The first mock exam is to improve the traditional teaching mode, and to introduce the content of MOOC into the teaching courses. Combining theory teaching with practice teaching not only enriches the teaching contents, but also ensures the diversification of information technology teaching. Activate the perspective of MOOC from the perspective of students and cultivate students' interest in the teaching content of information technology under the background of MOOC; Activating the teaching perspective from the perspective of teachers can greatly improve teachers' ability of information technology teaching, timely adjust teaching means according to the development trend of various industries in society, and integrate educational resources by using large-scale open online courses. MOOC teaching model is a teaching model biased towards science. According to the connotation of MOOC, constructivist learning theory and systematic teaching design theory, the theoretical basis is added on the basis of the implementation of MOOC, the specific process of classroom teaching is refined, and a more perfect MOOC teaching model is constructed, as shown in Figure 1.



**Figure 1:** MOOC learning teaching model.

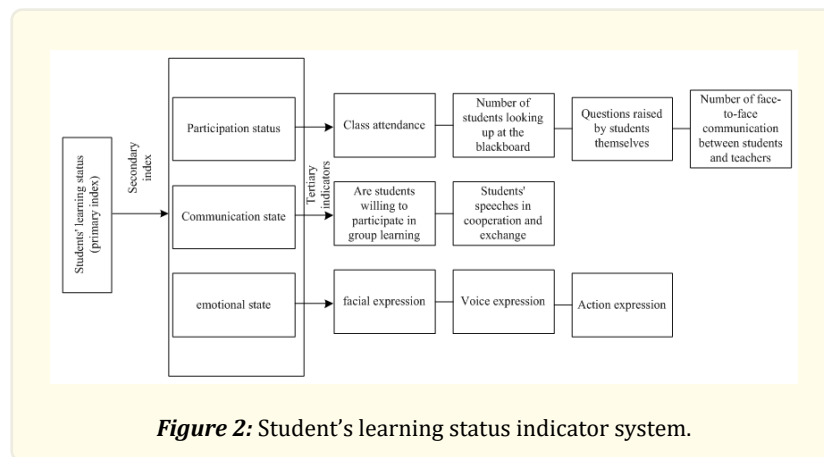
Inheritance and development of MOOC learning teaching model. The teaching model just stays on the main process of teaching and lacks the support of teaching theory. In addition to adding the support of teaching theory, it further refines the two teaching processes in the pre-class and class [7]. On the basis of the original two parts, the pre-class is refined into three parts: "watching teaching videos", "platform communication", and "pre-class practice". The 3 parts of the course are refined into 6 parts: "Identifying the problem", "Creating the environment", "Independent exploration", "Collaborative learning", "Communication of results" and "Feedback evaluation".

From the perspective of classroom teaching, we will find that due to the universality of this model, the pertinence of its discipline and education level is not strong. If it is used to evaluate the quality of subject courses, it needs to be further processed [8]. The teaching process is generally divided into four parts: checking preview and introducing new courses; Learning the content of the text; Knowledge consolidation and expansion. Compared with the traditional classroom, the flipped classroom is more efficient, intuitive, highly oriented and predictable in the pre-class stage, so students have a deeper understanding of what they have learned. Teachers only need to make comments in the link of "checking preview and introducing new courses". When learning each course, teachers should first grasp the context of the teaching design of each article, grasp the key problems and link them, that is, the "determined problems" mentioned in the model.

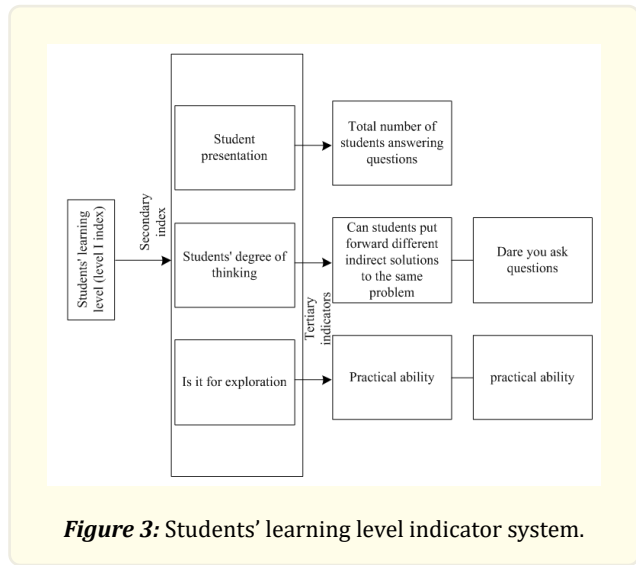
The design of the model is biased towards science teaching. In science teaching, there will be a single goal in each class. The explanation, application and scope of application will be discussed around this goal. Moreover, in the classroom teaching, each class will reflect the three-dimensional objectives of the new curriculum. Then, under the guidance of three-dimensional objectives, the teaching will produce a main line of explanation, and this main line will include all knowledge points. So far, this class teaching is perfect. "Check and preview, introduce new courses", "learning of text content" and "knowledge consolidation and expansion" are taken as the secondary indicators of evaluation, which are clearly reflected in the teaching model.

### Construction of an intelligent evaluation system for learning efficiency

The student's learning state index corresponds to three secondary indexes, namely the emotional state index, the communication state index and the participation state index. The emotional state in the secondary indicator corresponds to three tertiary indicators of unquantifiable facial expressions, voice expressions, and gesture expressions; the communication state in the secondary indicator corresponds to the tertiary indicator of whether students are willing to participate in group learning; participation in the secondary indicator the status corresponds to four three-level indicators: the number of class attendance, the number of students looking up at the blackboard, the situation of the students themselves asking questions, and the number of face-to-face exchanges between the students themselves and teachers. The quality of the evaluation index system is the premise of the success of teaching quality evaluation. Among them, facial expressions, voice expressions, and action expressions in the three-level indicators can be obtained instantly by computer through emotional calculation. Other parts of the three-level indicators can be calculated by computer in real time and fed back to teachers, and can also be observed and recorded by the evaluator by the on-site observation method. The distribution of secondary and tertiary indicators under the specific learning state indicators is shown in Figure 2.



The three secondary indicators corresponding to students' learning levels are students' expression, students' degree of thinking, and whether students have the courage to explore. Among them, the second level indicator is the sum of the number of times students answer questions, which corresponds to the third level indicator; The degree of students' thinking about problems in the secondary indicators corresponds to the two tertiary indicators: whether students can put forward different views and whether students dare to question; Whether the students in the secondary indicators have the courage to explore the corresponding two tertiary indicators: hands-on ability and practical ability. The distribution of specific students' learning level index system is shown in Figure 3.



Before the comprehensive evaluation of online learning efficiency, the evaluation set is first determined by the expert group, which mainly evaluates (comments) on each factor of learning efficiency evaluation [9]. The evaluation of each factor can be divided into multiple levels, and the specific evaluation and modeling are related to the goal to be achieved. Suppose the comments of each factor are m grades, which constitutes the judgment set  $V = \{V_1, V_2, \dots, V_m\}$ . All factors in this model use five grades of comments: high efficiency, high efficiency, medium efficiency, low efficiency and very low efficiency, which are recorded as:

$$P_{ij} = (1 + V) / \sum_{i=1}^m (1 + r_{ij}) - m \tag{1}$$

The entropy weight of the comprehensive available online English learning efficiency evaluation index is  $r_{ij}$ . In order to evaluate and investigate the five major factors that affect the efficiency of online learning, the degree of influence of each factor is divided into five levels: very high, high, medium, low, and very low [10]. The mean value of each survey influencing factor is taken as the influence rate of a certain student, and the specific content is shown in Table 2.

<i>Influence factor</i>	<i>Very high</i>	<i>High</i>	<i>Secondary</i>	<i>Low</i>	<i>Very low</i>
S1	0.2314	0.3526	0.3452	0.0798	0.2510
S2	0.2435	0.4565	0.2865	0.0389	0.0136
S3	0.1705	0.4465	0.3515	0.0435	0.0101
S4	0.2565	0.4135	0.2985	0.0535	0.0101
S5	0.2215	0.3256	0.3565	0.0568	0.0135

**Table 2:** Statistics that affect the efficiency of online learning.

After obtaining relevant data through investigation, the single-factor fuzzy judgment matrix can be determined. Taking into account the various stages of MOOC teaching, according to the Kirkpatrick's model, the MOOC teaching quality evaluation is divided into four parts: input evaluation, process evaluation, feedback evaluation and result evaluation. The input evaluation part mainly evaluates the initial level before the MOOC starts by collecting information such as students, teachers, teaching environment and facility support; the process evaluation part mainly evaluates the performance and teaching activities of students and teachers in the MOOC learning process, and objectively reflects The efficiency and quality of MOOC teaching practice; the feedback evaluation part mainly reflects their satisfaction with the MOOC teaching effect by evaluating the subjective feedback of students and teachers after the course; the outcome evaluation part mainly evaluates the objective results after the MOOC course, Compare initial input and subjective feedback to provide valuable improvements. The specific evaluation index system is shown in Table 3SUOSHI.

<i>Classification</i>	<i>Primary index</i>	<i>Secondary index</i>	<i>Specific indicators (examples)</i>
Input evaluation	Teaching preparation	Teachers' ability and willingness	Understanding of MOOC teaching Frontiers
		Students' ability and willingness	Subjective questions involved in MOOC learning
		Teaching management and facility investment	Matching degree of development courses with MOOC teaching model
Process evaluation	Teaching process	Student performance	Do students participate in online courses with quality and quantity
		Teacher performance	Production level of online courses
		Teaching management performance	Can we timely absorb the opinions and suggestions of teachers and students and make targeted adjustments
		Interactive performance	Online interaction enthusiasm of teachers and students
Reflection evaluation	Teaching feedback	Student feedback	Feedback on MOOC teachers' teaching level after the course
		Teacher feedback	Feedback on students' learning level after the course
Outcome evaluation	Teaching achievements	Student growth	Degree of self-awareness
		Teacher growth	Cumulative teaching experience

**Table 3:** The index system of MOOC teaching quality evaluation based on Kirkpatrick's model.

The original data of assessment and evaluation is the assessment content that the evaluation object fills in the results of his actual work or study according to the evaluation and evaluation system, plus the evaluation object and the assessment to form a piece of original data for the assessment and evaluation. The formal definition of the assessment and evaluation raw data is  $OD = (\text{Object}, C, \text{Content})$ , where  $OD$  is the assessment and evaluation original data,  $\text{Object}$  is the assessment object,  $C$  is the assessment, and  $\text{Content}$  is the assessment content filled in by the assessment  $\text{Object}$ . The assessment and evaluation raw data collection method  $M$ . As follows: First, determine the specific evaluation relationship according to the evaluation relationship model corresponding to the evaluation model, that is, determine who should fill in the original data of the evaluation and evaluation, and then, the evaluation object fills in the results of his actual work or learning according to the evaluation and evaluation system. For the assessment content, the software system finally stores the assessment and evaluation raw data in the database. The processing method  $M_a$  of the assessment and evaluation raw data is as follows: Summarize the assessment and evaluation raw data of the same evaluation object, and calculate the value of the evaluation object in each evaluation object according to formula (34). The workload on the assessment, and then add up the

workload on each assessment to get the total workload, thus forming the assessment result, as shown below:

$$w = p_{ij} + \sum_{i=1}^n w_i \times q_i \tag{2}$$

The primary index of process evaluation index is mainly divided into three aspects: teaching design, teaching process and teaching effect. Using the fuzzy Kirkpatrick's model and according to the scores given by the expert group, the fuzzy consistency is established through definition 2:

$$A = \begin{pmatrix} 0.5 & 0.3 & 0.7 \\ 0.7 & 0.5 & 0.9 \\ 0.3 & 0.1 & 0.5 \end{pmatrix} \tag{3}$$

The specific method of constructing the judgment matrix: take the criterion, that is, each element with downward subordinate relationship as the first element of the judgment matrix, place it in the upper left corner, and then arrange the elements belonging to it in the following first column and first row in order. The method usually used to fill in the judgment matrix: repeatedly ask the expert as the filling person for many times, According to the criteria of the judgment matrix, the elements are compared in pairs, the important elements are selected, and their importance degree is evaluated. The importance degree is assigned according to 1-9 using the importance scale value table (see Table 4 for the importance scale value).

<b>Factor ratio factor</b>	<b>Quantized value</b>
As important as	1
It's a little important	3
Very important	5
very important	7
Extremely important	9
Intermediate values of two adjacent judgments 2,4,6,8	

**Table 4:** Ratio scale.

Apply necessary mathematical methods to rank the judgment matrix filled in by experts. The hierarchical single ordering is essentially the calculation of the weight vector, which refers to the calculation of the relative weight of each factor in each judgment matrix for its criterion. The weight vector has the sum method, the power method, the root method, etc. matrix, and the desired weight is obtained by normalizing each column of it. For the judgment matrix with non-consistency, the result obtained by normalizing each column is only approximate to the corresponding weight, and the arithmetic mean of the n column vectors needs to be calculated as the final weight. The corresponding formula is:

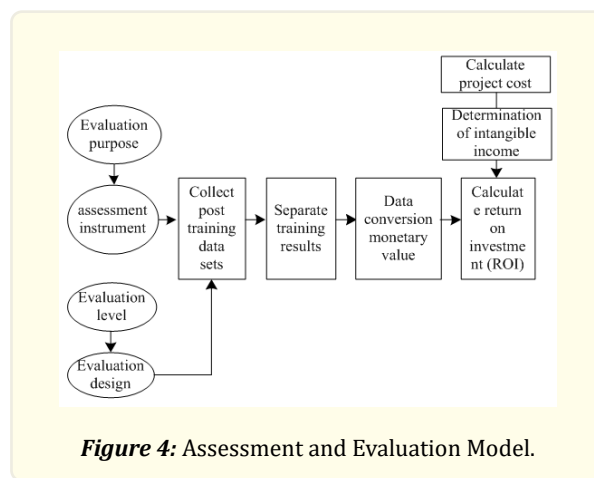
$$W_i = \frac{1}{n} - A \sum_{j=1}^n \frac{w}{\sum_{k=1}^n a_{kj}} \tag{4}$$

In some special cases, the judgment matrix can have consistency and transitivity. Generally, this property does not require the judgment matrix to be strictly satisfied. However, a correct ranking of the importance of judgment matrix needs a certain logical law from the perspective of human cognitive law. Therefore, in the process of practice, the judgment matrix requirements generally meet the

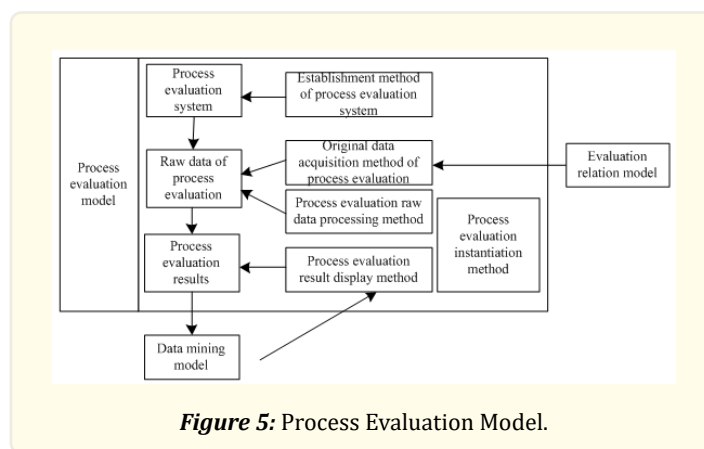
consistency, and the consistency test is required. Only when the judgment matrix passes the test, can it be logically reasonable, and then continue to analyze the results.

**Realization of intelligent evaluation of MOOC learning efficiency**

Phillips' five-layer evaluation model is a more representative one in the improvement of the Kirkpatrick's model. Jack Phillips is as famous as Donald Kirkpatrick in the field of training evaluation. Phillips believes that since the training usually only counts data such as cost, time, personnel, and achievements, it does not prove how much value the training brings to the organization and the return on investment brought by training, which is what policymakers are concerned about. Therefore, Phillips The fifth layer of return on investment is added to the original model, trying to convert the training results into specific benefits and returns. Kirkpatrick recognizes the supplement of the fifth layer to a certain extent, but it is difficult to directly convert the training results into monetary values, and a sufficient practical foundation is still needed. The evaluation model designed by Phillips is shown in Figure 4.

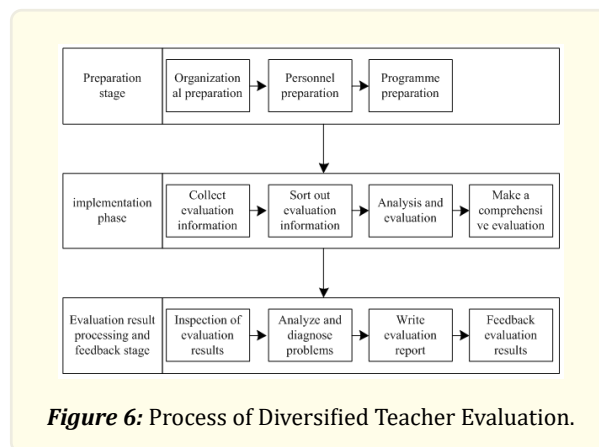


In the instantiation method, it is necessary to call the appraisal system creation method, appraisal original data collection method, appraisal original data processing method and appraisal result display method. The process evaluation model is shown in Figure 5.





The evaluation model abstracts and describes the procedural (formative) evaluation in the pluralistic evaluation. As shown in Figure 6.



The process evaluation model includes process evaluation system and its creation method, process evaluation raw data and its collection and processing method, process evaluation results and their display method, and process evaluation instantiation method.

Among them, data mining model and evaluation relationship model do not belong to process evaluation model. They are preparation stage, implementation stage and evaluation result processing and feedback stage respectively. Evaluation preparation stage is the initial link of evaluation activities. Sufficient preparation in this stage will lay a good foundation for follow-up work and ensure the smooth progress of evaluation work. This stage mainly includes organizational preparation, personnel preparation and program preparation. Among them, organizational preparation and personnel preparation are mainly to organize the evaluation implementers to study theory and complete the evaluation work scientifically and correctly. Scheme preparation is the core part of this stage, and the main task is to determine the evaluation model.

This research adopts the Kirkpatrick's model to establish an evaluation model that meets the evaluation objectives and suits the evaluation object on the basis of the existing evaluation system. The processing and feedback of the evaluation results are the last stage. This stage is mainly to extract useful information from the evaluation results through data mining tools, which can analyze and diagnose problems in teaching, help leaders to make relevant decisions, and can also motivate the evaluated objects to continuously improve and perfect themselves. The process of diversified evaluation is closely linked and closely linked. By collecting evaluation data, processing evaluation data, and analyzing evaluation data, feedback is given to leading decision-makers in an intuitive form.

### Analysis of experimental results

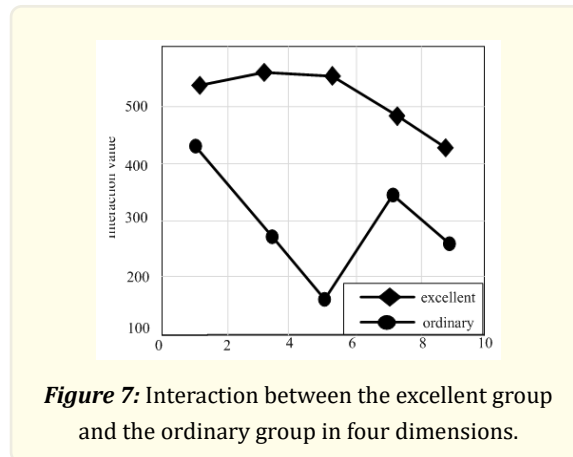
In order to verify the application performance of the intelligent evaluation method of MOOC learning efficiency based on the Kirkpatrick's model, the following experiments are designed.

First, the scores of each dimension of the excellent group and the ordinary group using the MOOC model are listed in Table 5.

	<i>Excellent group</i>	<i>General group</i>
Dimension A	3.65±0.18	0.71±0.81
Dimension B	3.71±0.35	0.91±1.05
Dimension C	3.68±0.15	2.25±0.85
Dimension D	2.95±0.61	1.65±0.31

**Table 5:** The mean and standard deviation of the excellent group and the ordinary group in four dimensions.

Through repeated measurement and analysis of the data in Table 5, the main effect of classroom type is significant  $P = 143.6p$  (0.001). The score of excellent MOOC teaching is significantly higher than that of ordinary MOOC teaching, and the main effect of each dimension is significant ( $25.6 < 0.001$ ), that is, there are significant differences in the scores of each dimension. The interaction between classroom type and each dimension is significant. The specific results are shown in Figure 7.



The scores of the excellent group in all four dimensions are significantly higher than those of the ordinary excellent group. The excellent group scored higher in micro-video, self-learning task list, and teaching behavior; and lower in student behavior; but overall there was little change. Comparing the scores of the ordinary group on the four dimensions, it can be found that the ordinary group has little changes in micro-video and teacher behavior; and has a lower score in the self-learning task.

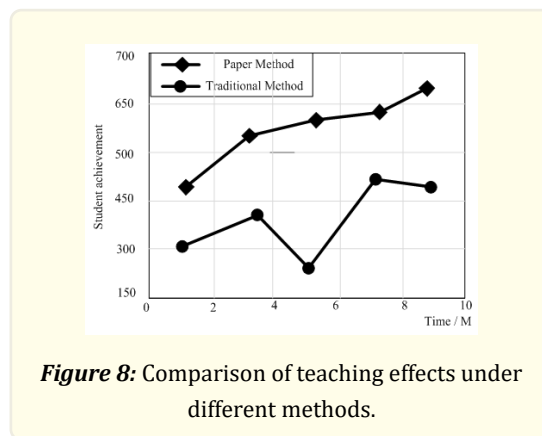
In the gap between the excellent group and the ordinary group in the autonomous learning task unilateral analysis, the reason for the difference between the excellent group and the ordinary group in the “autonomous learning task list” is due to the inconsistency of the teaching sequence after the flip. In view of the improvement of teachers’ teaching methods, it is necessary to refine the teaching time and strengthen the effective interaction between teachers and students. Following the teaching reform concept of the 19<sup>th</sup> National Congress of the Communist Party of China can promote the teaching system to adapt to the current teaching policy reform. In order to improve the reliability of this study, the traditional teaching method was compared with the information technology teaching method based on the MOOC background, and the results are shown in Table 6.

	<i>Experiment group</i>	<i>Improper teaching schedule</i>	<i>Less interaction between teachers and students</i>	<i>Mastery /%</i>
Traditional teaching methods	A	nothing	have	41
	B	have	nothing	36
	C	nothing	nothing	63
	D	have	have	11
Teaching methods under the background of teaching	A	have	have	74
	B	nothing	have	73
	C	have	nothing	86
	D	nothing	nothing	61

**Table 6:** Comparison results of two teaching methods on students’ information technology mastery ability.

It can be seen from Table 6 that there is a great difference in students' mastery ability of information technology discipline in the absence of teaching time arrangement between the two teaching methods. It can be seen that under the background of class worship, improving teachers' teaching methods can improve students' ability to master information technology. In the traditional classroom teaching process, the order of teaching and learning is to teach first and then learn. The classroom is called the classroom because the teacher is the place to teach. Here, the teacher learns from the students first and learns from the time.

The full score of the students' total subject score is set to 700. Through the figure, we can more clearly understand the advantages of the system design.



It can be seen from the figure that the method in this paper can not only improve the performance of students, but also save time, which brings great convenience to students who cannot solve problems in time at home.

## Conclusion

Massive Open Online Course (MOOC) is a brand new kind of online teaching The way of education. In the traditional teaching mode, test score is the only measure, which leads students to memorize passively in order to improve their performance Pay the exam, in the face of the problem without their own independent thinking, the results of the training of students "one side". Learning-centered teaching Learning and teaching evaluation change from the result evaluation to the combination of results and process evaluation. Students' grades are mainly based on their usual grades The course teacher makes a detailed record of the students' usual learning status, and the students' learning process in class speech, after-class discussion, homework inspection Paper writing, experimental research and so on will become the evaluation basis of their usual results, which promotes students to a certain extent after class Careful preparation, active thinking in class, actively speak, participate in the discussion, mobilize the enthusiasm of students learning, improve the classroom teaching The effect of learning. To achieve this goal in the regular classroom, teachers need to pay a lot of time and energy to collect and count students The data of the learning process will not only affect the development of other teaching activities, but also often the statistical data is not objective and comprehensive enough. The intervention of information technology has greatly solved the difficult problem of teaching evaluation. As a widely used training effect evaluation model, Kirkpatrick's model has internal consistency between its evaluation idea and the requirements of students' multiple balance. In order to improve the evaluation of curriculum effect, this study is carried out from four aspects: response, learning, behavior and result.

In the future research, further optimization will be carried out from the following aspects: first, MOOC education should not be greedy for more and faster, but should follow the teaching value orientation and scientifically build a high-quality course platform; Second, we should pay attention to the connection between teaching materials and courses, and design the teaching objectives of classification and stratification; Third, urge students to learn independently before and during class, and encourage students to share and feedback communication, so as to improve students' autonomous learning efficiency and self-confidence.

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