

Design and Evaluation of Blended Teaching Mode Based on MOOC

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Abstract—With the development of the Internet and the gradual change of teaching concepts, the combination of Internet technology and traditional classroom has become the development direction of teaching reform. In this paper, we take linear algebra course as an example to design a hybrid teaching model based on MOOC by using the existing MOOC resources, and construct its quality evaluation index system and evaluation model by using AHP, calculate and tests the eigenvalues of the evaluation matrix in this paper. Numerical simulations verify the effectiveness of the algorithm and model.

Keywords—MOOC, mixed teaching mode, AHP, evaluation

I. INTRODUCTION

Mathematics course is an important basic course in Navigation Engineering colleges. It has many distinct characteristics, such as interlacing contents, close connection between knowledge and classroom information, and its knowledge system has obvious logical relationship. Such a highly rigorous and logical curriculum is currently facing the dilemma of being constantly reduced[1]. The reason is, on the one hand, the fact that colleges and universities continue to expand their enrollment background. According to statistics, 2.21 million people were admitted to the National College Entrance Examination in 2000, 6.57 million in 2010, and 7.72 million by 2017. The rapid growth of enrollment has resulted in a relative shortage of teaching resources, and this trend is becoming more and more intense. On the other hand, due to the semi-military management system, students can use a large part of the time for autonomous learning is very limited, and the hours of various courses are constantly reduced, teachers have to explain a large number of professional knowledge in a limited class time, training programs in knowledge goals, ability goals, emotional goals difficult to fall well. At the same time, with the development of communication and interconnection technology, electronic mobile terminals have begun to pour into university classes because of their mobile characteristics, it make the students can easily get a lot of course information[2]. Based on the above background, it is necessary to improve and explore a kind of mixed teaching

mode of mathematics courses in Navigation Engineering colleges, and evaluate the effect of this mixed teaching mode.

II. MIXED TEACHING MODE

A. Characteristics of Mixed Mode

Mixed teaching mode refers to the combination of traditional classroom with MOOC and its derivative models such as Wrapped MOOC, SPOC, flipped classroom, micro-classroom and so on. MOOC and its derivative learning resources provide a new mode of knowledge dissemination and learning[3]. Because the mixed mode breaks through the limitation of traditional classroom time and space, the students can choose personalized information resources according to their own requirements. At the same time, there is a lack of assessment system, and learners need to have a strong ability to learn independently to complete the course on time, MOOC also has a high drop-out rate. The disadvantages of MOOC are the advantages of traditional classroom, and its advantages can make up for the shortcomings of traditional classroom teaching. Therefore, traditional teaching and MOOC[4] have their own advantages. Under the above background, we try to use the advantages of traditional classroom and MOOC, take linear algebra course of navigation specialty as an example, explore and design the hybrid teaching mode based on MOOC.

B. Existing Research

By analyzing the relevant research of MOOC at home and abroad in recent years, it is found that most of the research involving the theoretical level of curriculum evaluation index system is to sort out the existing MOOC open course construction. Chen Xinyi [5] from the perspective of research methods, put forward the research object, research content and research significance of building MOOC quality evaluation system for innovation and entrepreneurship; Cathy Sandeen [6] analyzed the evolution process of MOOC, pointed out that effective evaluation of MOOC curriculum can better enable students to gain. Other researches are applied to the MOOC curriculum evaluation system. Yousef[7] evaluates MOOC curriculum quality from user interface, curriculum content, social tools, learning methods, etc. Qiu Junping [8] establishes

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MOOC quality evaluation system from five dimensions: teaching team, teaching content, teaching resources, teaching effect and teaching technology, and uses fuzzy evaluation. Chen Hongxia [9] evaluates the quality of MOOC from four dimensions: teaching content and resources, teaching design and methods, teaching activities and evaluation, teaching technology and guarantee. Zhao Xin, Li Guojun etc.[10-11] uses fuzzy analytic hierarchy process to evaluate the quality of network course website. However, the existing research does not consider the student level in depth and carry out empirical analysis; as the subject and receiver of MOOC curriculum, students' learning situation is related to the dropout rate and curriculum completion rate of MOOC curriculum, which is one of the dimensions to be considered in MOOC curriculum evaluation.

Therefore, we try to construct a MOOC-based hybrid teaching model curriculum evaluation index system, which is based on the traditional curriculum evaluation indicators, combined with the characteristics of MOOC curriculum, starting from the four aspects of teachers, students, MOOC curriculum design and learning effect.

III. ANALYTIC HIERARCHY PROCESS

Analytic Hierarchy Process (AHP) refers to the decision-making method that decomposes the elements that are always related to decision-making into objectives, criteria, schemes and so on, and makes qualitative and quantitative analysis on this basis. This method is a hierarchical weight decision analysis method proposed by American Operations Research Professor Sarty of the University of Pittsburgh in the early 1970s

A. Characteristics of Professional Courses

The training objective of our maritime major is to cultivate high-level maritime technical personnel with international competitiveness. The main courses of this major are: navigation mechanics, ship principle, navigation, electronic chart display and information system, ship collision avoidance, navigation instruments, GMDSS equipment and communication services. Linear algebra is a branch of mathematics. Its object of study is vector, vector space (or linear space), linear transformation and finite dimensional linear equations.

We surveyed all the textbooks for undergraduate students at the Navigation College of our university and summarized the courses and textbooks related to linear algebra.

It is found that there are five courses, seven chapters used linear algebra equations module, four courses, six chapters used linear algebra matrix module, in addition, there are two courses, two chapters used linear algebra similar matrix and quadratic module.

B. Online Course Selection and Design

According to the characteristics and difficulties of different knowledge modules of linear algebra, the existing MOOC resources are classified and the mixed mode of MOOC + traditional classroom is designed.

Some MOOC videos, which are short in time, novel in content and closely related to classroom topics, can be selected as homework for pre-class preview and as a topic for classroom instruction in order to stimulate students' curiosity and activate the class [Fig. 1-Fig. 2]. The atmosphere of the class improves students' learning efficiency. students' learning efficiency.

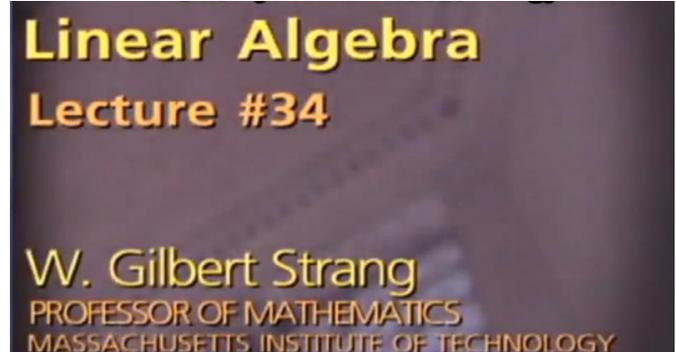


Fig. 1. MIT Open Course: Linear Algebra



Fig. 2. A Open Course of Khan College: Linear Algebra

MOOC can explain the emphasis of the course. Through interviewing and investigating the students, we find that most of the students are difficult to grasp the key and difficult points in the classroom under a large amount of classroom information. In this case, teachers can assess the difficulty position of the teaching module according to their previous teaching experience, and choose to play MOOC video about the teaching difficulty in class to help students understand the difficulty, such as [Fig. 3-Fig. 4].

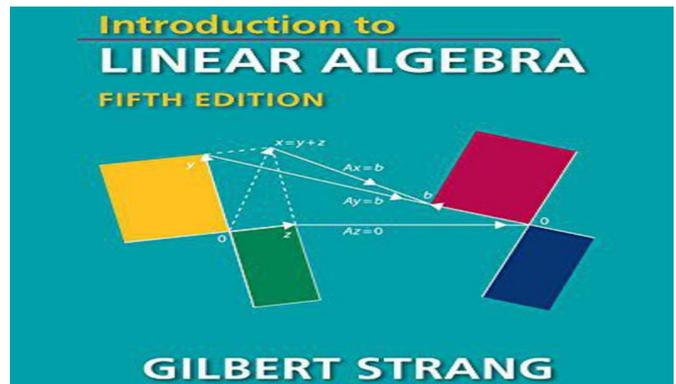


Fig. 3. Introduction to Linear Algebra

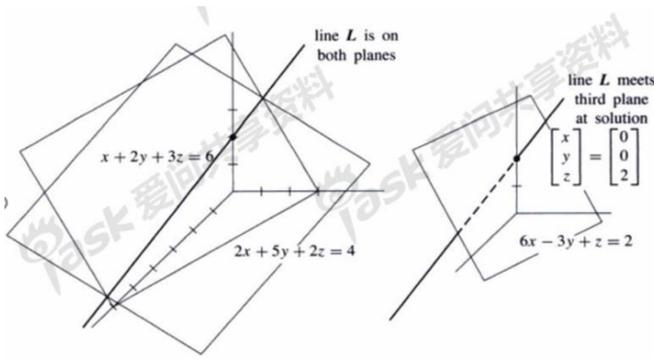


Fig. 4. Screen capture for solving linear equations

C. Evaluation Model

Evaluation is the most effective strategy to accept and promote a kind of education mode. We use the analytic hierarchy process to construct the quality evaluation index system of MOOC blended teaching mode. The detailed analysis steps are as follows:

step1. Establish objectives and establish a hierarchical structure of Wrapped MOOC quality evaluation index system.

step 2. Conduct expert consultation, construct judgement matrix and calculate weight vector. Each expert gives the judgment matrix for each layer, and uses the eigenvector method to find the weight vector of the judgment matrix, and then checks the consistency of each judgment matrix to decide whether to start or not.

step 3. To form an evaluation plan.

$$M = W_{1A} X = \sum_i \beta_i X_i = \sum_i \beta_i \sum_j a_{ij} x_{ij} \tag{1}$$

Among them, the score of the quality effect evaluation corresponds to the weight of the two or three grade index. The hierarchical diagram is as follows.

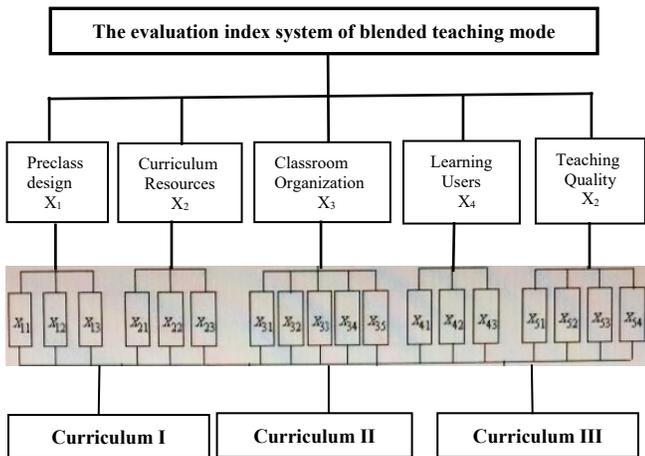


Fig. 5. Teaching quality evaluation index system

In the Fig. 5, the first level is the target layer A, the two middle level is the criterion layer C1 and C2, and the last level is the measure level P.

- Pre-class design X_1 including video editing, synthesis; message board, supporting assignments, exercises and tests; video communication support and interaction. The sub-indexes are recorded as X_{11}, X_{12}, X_{13} .
- Curriculum resources X_2 include teaching plan, knowledge association, content and structure; MOOC resources selection; curriculum development resources links. The sub-indexes are recorded as X_{21}, X_{22}, X_{23} .
- Classroom organization X_3 includes the determination of key and difficult points; classroom organization; heuristic teaching. The sub-indexes are recorded as $X_{31}, X_{32}, X_{33}, X_{34}, X_{35}$.
- Learning users X_4 include the completion rate of homework exercises; click-through rate of curriculum development resources; student feedback effect; student liking; curriculum passing rate. The sub-indexes are recorded as X_{41}, X_{42}, X_{43} .
- Teaching quality X_5 includes teaching attitude; key and difficult treatment; systematisms and logic; classroom atmosphere, oral and pronunciation, blackboard writing. The sub-indexes are recorded as X_{51}, X_{52}, X_{53} .

Through calculation, we get Rule level C1 eigenvector for target layer A is

$$W_{1A} = (\beta_1, \beta_2, \beta_3, \beta_4, \beta_5) = (0.089, 0.178, 0.205, 0.054, 0.456)$$

The consistency test index $CR = 0.0177 < 0.10$ was verified by Yaahp statistical software and passed the requirement of consistency test.

By repeating the above method, the judgment matrix and eigenvectors of the criterion layer C2 (sub-index) to the criterion layer C1 are obtained.

$$W_{21} = (a_{11}, a_{12}, a_{13}) = (0.724, 0.193, 0.083)$$

$$W_{22} = (a_{21}, a_{22}, a_{23}) = (0.231, 0.664, 0.105)$$

$$W_{23} = (a_{31}, a_{32}, a_{33}, a_{34}, a_{35}) = (0.200, 0.200, 0.200, 0.200, 0.200)$$

$$W_{24} = (a_{41}, a_{42}, a_{43}) = (0.250, 0.417, 0.333)$$

$$W_{25} = (a_{51}, a_{52}, a_{53}, a_{54}) = (0.048, 0.165, 0.394, 0.394)$$

And their CR is less than 0.10, which conforms to the requirement of consistency test.

D. Numerical Test

The results show that the five elements of Criterion Level C1 are pre-class design, curriculum resources, classroom organization, learning users and teaching quality. The teaching quality has the most weighted value, the value of it is 0.454, the learning user has the least weighted value, the value of it is 0.055. The results of numerical tests are shown in Table I.

Using this index system model, we simulated the linear algebra course of four natural classes and get the

comprehensive quality evaluation scores of 89.3, 90.5, 94.1, 93.7 respectively. According to the result of each upper level

index score size, teachers can be targeted to improve, improve the sub-index score.

TABLE I. RELATIVE IMPORTANCE

	Pre-class design	Curriculum resources	Classroom management	Learning users	Teaching quality
Pre-class design	1	1	1/3	2	1/5
Curriculum resources	1	1	1/3	2	1/5
Classroom management	3	3	1	3	1/3
Learning users	1/2	1/2	1/3	1	1/7
Teaching quality	5	5	3	7	1
W_{IA}	0.088	0.179	0.204	0.055	0.454

IV. CONCLUSIONS

This paper has made some contributions to the establishment of the evaluation index system of the blended teaching mode and the evaluation result of this model can strengthen the quality control of mixed teaching and help to improve the teaching quality and effect. In addition, using the multimedia function of MOOC, teachers can give dynamic geometric explanations of highly abstract concepts and theorems, making classroom teaching more intuitive and vivid. For example, when talking about some common quadric surfaces and curves can be described in a dynamic form from the point of motion into a curve. How does a curve move into a curved surface? Reasonable use of multimedia in teaching can not only improve the enthusiasm and initiative of students, but also reduce the abstraction and boring of mathematical knowledge.

The exploration of teaching mode in higher education has never stopped. With the development of electronic information, computer and network technology, the mixed teaching mode is undoubtedly the most advanced and reasonable teaching mode at present. It realizes the inheritance and transcendence of MOOC and solves the main problems faced by MOOC effectively. The teaching effect is improved. In the pursuit of educational equity and individualization today, mixed education model will become the future trend of development, will gradually become the main direction of the future reform of higher education teaching model.

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