All-round Evaluation Method for Multi-media Teaching

Yuanwei Du
Faculty of Management and Economics, Kunming University of Science and Technology, Kunming, Yunnan, 650093, China
Email: duyuanwei@gmail.com

Chen Han, Hongjuan Yang and Wanchun Duan
Faculty of Management and Economics, Kunming University of Science and Technology, Kunming, Yunnan, 650093, China
Email: nanceorange@sina.com

Abstract—In order to solve the problem that comprehensive effects of multi-media teaching can’t be evaluated systematically in current research, an all-round evaluation system is constructed to evaluate multi-media teaching systematically and omni-directionally by objective element designing, subjective element selecting, and objective-subjective integrating. After that, the all-round evaluation thought for multi-media teaching is discussed by designing evaluation processes and deriving evaluation weights. According to some qualitative or quantitative methods such as Brain Storming, Nominal Group Technique or Analytic Network Process, subjective and objective weight deriving methods and integrating methods for multi-media teaching all-round evaluation are presented finally. A numerical example proves the all-round evaluation method for multi-media teaching is applicable and feasible.

Index Terms—multi-media teaching; all-round evaluation system; evaluation index; evaluation weight

I. INTRODUCTION

With the high-speed development of information technology, multi-media teaching becomes an important method in modern school education already. It makes teaching model changes from traditional methods such as ‘one mouth, one chalk and one blackboard’ becomes to a modern method as ‘a fusion of teachers’ speeches and students’ learning’. During the process of multi-media teaching, knowledge which is lectured could be demonstrated via pictures, sounds, images and many other different ways. Teachers also could interpret and explain the questions which are important and difficult efficiently. Using multiple provokes such as vision and audition to deepen knowledge comprehension of students, thereby makes knowledge lectures be delivered and transferred under the teaching scene of directly perceived through the senses, third dimension and dynamic senses, in favor of guarantee the teaching effect in class. Although this teaching method has already been adopted by many universities, colleges, schools and scientific research institutes, influenced by traditional teaching model, during the teaching process there is still existing a problem that the multi-media as an substitute of traditional teaching method.

Under this situation, multi-media teaching cannot express its advantages enough, thus cannot acquire the teaching result should be achieved [1,2]. To solve this problem, numerous experts and scholars launch their study for the evaluate problem of multi-media teaching’s effect by combining the real teaching process. As the relative literature so far, available achievements either point at the research of evaluate index system of problems happened in multi-media teaching, or point at combine the features of multi-media teaching’s effect to research its evaluate index system [3,5]. Which could be affirmative is, these research findings could not only help to abundant evaluate theory system of multi-media teaching, but also in favor of promoting multi-media technologies’ efficiency in real teaching process. However, which should be realized is, these research findings merely launch their evaluations from the aspects of manufacture of courseware, design of teaching contents and so on, or merely be established in visual angles of students and experts, which means cannot reflect multi-media teaching synthetically result systematically and omni-directionally. Thus the scientifically and efficiency of the research finding is still waiting for discussing. In consideration of the advance of multi-media teaching’s effect is a system management question, this article means to construct a method of an omni-direction evaluation from the vision angle of teachers, experts and students on the foundation of analyzing all-round multi-media teaching evaluation system.

II. ALL-ROUND MULTI-MEDIA TEACHING EVALUATION SYSTEM

In order to make an all-round evaluation of multi-media teaching effects systematically, the design of evaluation system should embody its instructional standard and discipline in three aspects of objects elements design, subjects elements selection and both subjects and objects elements integration[1-5]. In particular,
first of all, the design should follow the principle that ‘the purpose and the design of evaluation have homogeneity’; ‘the construction of evaluation system has integrity’ and ‘the efficiency of evaluation information’. Secondly, to reflect complexity and dynamics of knowledge propagating, the design should reflect the whole process of teaching. Finally, in order to evaluate multi-media teaching objectively and justly, the objects who take part in evaluation should embody the principle of ‘the Trinity’. Namely the objects should cover the students as knowledge receivers, should cover the teachers as knowledge delivers and should cover the experts as bystanders. Thus, the all-round multi-media teaching evaluation system could be expressed by Figure 1.

![All-round evaluation system of multi-media teaching](image)

Figure 1. All-round evaluation system of multi-media teaching

What needs to be illustrated is the design of multi-media teaching system should set out from the whole process of teaching. By constructing the evaluation index separately for teaching preparing phase, teaching implement phase and teaching feedback phase. Specifically expound as follow:

A. Teaching Preparing Phase

Evaluation indices of teaching content design. The design of teaching content is directly relative to the multi-media teaching’s result. Specifically, teaching content should aim at teaching to define the purpose systematically and has the stress to the definition, principle, model, the equation, formula, case and other aspects of the teaching design. Teaching content design evaluation could launch as follow aspects: clear degree of teaching purpose, system degree of teaching content and rational degree of construction design.

Evaluation indices of multi-media courseware. As intermediation of teaching content spread, multi-media courseware could not only emerge specific content of teaching by visualized images and words, but also adjust students’ learning emotion by special cartoons and sounds. By this way, multi-media courseware could enhance the efficiency of multi-media teaching. Multi-media courseware evaluation could launch as follow aspects: comprehensiveness of teaching content, significance of emphasizes and difficult point, availability of knowledge express.

Evaluation indices of lecture method conception. Teaching content could be expressed to students or not depends on the conception of teaching method. An efficient teaching method could arouse interests of student speedily and could take students into good learning status quickly. Thereby, knowledge could be expressed and transferred efficiently. The evaluation of lecture method conception could launch as follow aspects: thought provoking of knowledge lecture, interactivity of teaching process and utilization of multi-media equipments.

B. Teaching Implement Phase

Evaluation indices of classroom instruction organization. Classroom teaching is a series of activities that have the aid of multi-media teaching equipments then finish teaching target. In the process of classroom instruction, teachers need to be immersed in instruction fervidly, but also need to keep the discipline of class and grasp the teaching schedule. The evaluation of classroom instruction organization could be launched as follow aspects: the proficiency of equipments, the attitude of develop multi-media teaching and the control of teaching rhythm.

Evaluation indices of study enthusiasm remove. The students will input multi-media teaching actively only when their study enthusiasm is removed enough. On one hand, the study enthusiasm is manifesting as students could obey the class discipline initiatively. On the other hand, independent consideration and put forward relative questions also could embody the study enthusiasm. The evaluation of study enthusiasm could be launched as follow aspects: degree of obeying class discipline, degree.
of take part in interaction actively and active degree of put forward questions.

Evaluation indices of teaching content lecture. As an organized dynamic combination of experience, value, relative information and insight, knowledge needs to comment and absorb new experience and information continually. Teachers need to express the newest knowledge which is relative to the course to the students timely and effectively, can make students grasp the latest technology progress and understand the frontier dynamic. The evaluation of teaching content lecture could be launched as follow aspects: innovation degree of teaching method, effect of knowledge receiver and efficiency of knowledge receiver.

C. Teaching Feedback Phase

Evaluation indices of homework correction. Students are the only side that can benefit from homework (consolidate the knowledge has received). However, the correction for homework is an efficient method which can make both teachers and students beneficial. Homework correction could find out existing problems during teaching and learning process. By this way, teachers could improve teaching method, enhance teaching quality. At same time, students could solve difficult questions, correct mistakes. Evaluation of homework correction could be launched as follow aspects: rational degree of homework quantity, rational degree of homework difficulty, particular degree of homework comment.

Evaluation indices of question solve after class. It is well known that ‘find out the problem equal to solved half of it’. For students, the only way to help them enhance their level is to find out new questions constantly. However, for the same question, different dealing methods might get different results. Also can say, the better dispose of questions which are put forward by students, the better the study ability will be. In this process, teachers are the catalyst who can help to enhance this ability. Evaluation of question solve after class could be launched as follow aspects: the timely degree of question solve, the scientification degree of question solve and the particular degree of question solve.

Evaluation indices of teaching experience summarization. Teaching experience accumulate on the foundation of solving questions in the teaching process constantly. The richer teaching experience means the better teaching effect. Although teachers’ experience will accumulate during the teaching process, the speed of accumulation is not all the same—that’s because the attitude and methods how teachers treat their work will influence their speed. Evaluation of teaching experience summarization could be launched as follow aspects: frequency of experience summarization period, the profound degree of experience summarization and the inspiration degree of experience summarization.

In order to evaluate the multimedia teaching effect systematically, we expound the all-round evaluation of multi-media teaching from two aspects as the design of evaluation process and the assignment of evaluation weights. In this process of construct the overall evaluation index, we always treat the ‘trinity’ principle as foundation.

Design of evaluation process should obey the traditional process. Namely combine the evaluation index system of multi-media teaching purpose and features construction firstly (which have been introduced before). Then pick up the evaluation information of every subject be evaluated by specific methods (such as questionnaire survey and interviewing method) which according to evaluation index system. Finally, we get the comprehensive evaluation value of multi-media result by the combination of evaluation information. Which need to be illustrate are: on one hand, the collection of evaluation information should combine the features of evaluation subjects. As we illustrated before, evaluation subjects include students, teachers and experts. Among them, as the object subjects students could evaluate the teaching effect from their own knowledge, the enhance degree of ability of teaching implement phase and teaching feedback phase. As the executive subjects, teachers could evaluate themselves about their hard working and teaching results during the whole process. Experts as the observe subjects, could give objective evaluation of teaching preparing phase and implement phase through teaching data checking and class process feeling. One the other hand, the evaluation information should be integrated by both objects and subjects. The subjective information is summarized from students, teachers and experts; the meaning of it is to survey the teaching results in different angles. The objective information is described by different index in the index system, which could reflect both advantages and disadvantages of teaching effect. We could expound evaluation systematically only when the different angles and information that reflects different aspects are combined comprehensively. Especially, both the objective and subjective information works through evaluation index value. For showing the different between information features, we will separate the objective ones and subjective one before we discuss them.

Evaluation weights are working for balancing relevant important degree of objective and subjective information. These weights could divide into subjective weights and objective weights. Subjective weights could reflect relevant important degree for the same question’s judgment of student, teachers and experts as well. Objective weights could reflect relevant important degree of different evaluation information in index system. Specifically, subjective weights should combine the comprehensive degree or the perception degree of multi-media teaching evaluation index of evaluation subjects. For instance, considering during the process of evaluating themselves, teachers might make the things benefit for themselves, the evaluation of experts is more important than teachers’ self-assessment during the teaching
preparing phase. Considering the final purpose of multi-media teaching is enhancing the qualities and abilities of students, the evaluation information of students is more important than teachers’ self-assessment and experts’ evaluation during teaching implement phase. Considering teachers are clear about their attitudes of teaching, and there might be revenge actions by students because they have been criticized by teachers, the self evaluation by teachers should be more important than students’ assessment during teaching feedback phase. Objective weights should combine evaluation index then assign the influential degree of multi-media effect. For example, the teaching style designs of teachers during teaching preparing phase might be too innovation to be received by experts, but the implement effect might be great. This situation means, teaching preparing phase services for teaching implement phase, thus the evaluation index in implement phase is more important than the index in preparing phase. For the sake of reasons above, the all-round evaluation mentality could be described by Figure 2 as below.

![Figure 2. All-round evaluation meditation of multi-media teaching](image)

**IV. EMPOWERMENT AND INTEGRATION METHD OF SUBJECTIVE AND OBJECTIVE WEIGHT**

We could confirm both the subjective weights and objective weights according to the relative policy document of multi-media teaching administrative department. The specific value of weight might be different for the difference of policies. For the subjective weight, the empowerment objects are teachers, students and experts. Because of the number of objects is rarely, we could confirm it by using methods as brain-storming method of nominal group technology and so on [6]. When the decision experts group (empowerment objects) of multi-media teaching management apartment could interact and arouse their thinking resonance, we could use brain-storming method to confirm the objective weight. When decision group do not aware of the features of question and have serious division, we could use nominal group technology to confirm the objective weight. As is known by Figure 2, the evaluation information is given by teachers and experts during the teaching preparing phase, so we could suppose the objective weights of them are \( sa_t \) and \( sa_e \) (\( sa_t + sa_e = 1, sa_t > 0, sa_e > 0 \)). The evaluation information is given by teachers, students and experts during teaching implement phase, so we could suppose that the objective weights of them are \( sb_t \), \( sb_s \) and \( sb_e \) (\( sb_t + sb_s + sb_e = 1, sb_t > 0, sb_s > 0, sb_e > 0 \)). The evaluation information is given by teachers and students during the teaching feedback phase, so we could suppose that the objective weights of them are \( sc_t \) and \( sc_s \) (\( sc_t + sc_s = 1, sc_t > 0, sc_s > 0 \)).

For the objective weight, the empower targets include 27 indices such as explicit degree of teaching purpose, the systematic degree of teaching content, the reasonable degree of structure design. These 27 indices could divide into three levels as high level, middle level and low level according to their styles and quantities. Namely these 27 indices described above are the bottom index, Then according to the classify standard of part 2 combine the bottom index to middle level index set (9 index sets such as teaching content design, multi-media courseware making and so on) and the highest level index set (teaching preparing phase index sets, teaching implement...
phase index sets and teaching feedback phase index sets). These objective factors are not only numerous and varied (which include 27 indices, 3 high level index sets and 9 middle level index sets), but also exist complex relationships between them. For example, in the lowest level index, the explicit degree of teaching content of teaching content design will influence systematical degree of teaching content and reasonable degree of structure design. In the middle level index sets, the index sets of teaching content design will influence the index sets of multi-media courseware making and teaching methods meditating. In the highest level index sets, the index sets of teaching preparing phase will influence the index sets of teaching implement phase, the index sets of teaching implement phase will influence the index sets of teaching feedback phase, the index sets of teaching feedback will influence the index sets of teaching preparing phase in next round.

Considering reasons above, we adopt the Analytic Network Process (ANP), which could deal with complex structure relationships in system efficiently to confirm the objective weight. ANP was suggested by Dr. Saaty that could solve complex system nonlinear problems in the situation which are existing dependency and influence relationships. As an evaluation and decision method, ANP has been used broadly for solving management decision problems in lots of scales. Using ANP method for confirming objective weights has two advantages. Firstly, the multiple comparison judgment models is one feature of ANP, this kind of model makes efficient judgment of decision maker under the condition of numerous index and complex relationships between these index possible. Secondly, the weighted super matrix and the limit influence could reflect and analyze the complex relationships and influence mechanism of system interior. The construction method of objective weights based on ANP is described as below.

**Step 1:** Analyzing problems and constructing system analyzing structure. By analyzing of these index sets or depending influence relationships between them, we could construct an analyzing structure of confirming objective weights (as Figure 3). In Figure 3, the arrow line means the index sets of tail could dominate the index sets of head; arc arrow line means the index sets are existing interdependent relations (the internal indices are interdependent).

**Step 2:** Constructing hypermatrix based on system analyzing structure. As is known by analyzing structure of all-round evaluation of multi-media teaching structure, all the middle level index sets have interdependent relations internally; and some of the index sets have dominance relationships. For every index of middle level, we could treat everyone of them as a control principle. According to multiple comparison method of AHP, construct judgment matrix which could reflect the relative important degree between middle indices of relevant index sets. Then base on the matrix using the traditional characteristic root method seek out their index weights and their internal dependent matrix. For instance, in the sets of teaching content design, we construct the multiple comparison judgment matrices of $A_{11}$, $A_{12}$, $A_{13}$, we treat $A_i (i=1,2,3)$ as control standards. Then seek out the weight vectors of $A_{11}$, $A_{12}$ and $A_{13}$ under 3 control standards. Finally, by combining those weight vectors, we could get the internal dependent matrix of indices set $A_i$. For 2 index sets which have dominance relationship, let one random index of dominate index sets (the tail) as the control principle, according to the multiple comparison judgment method, construct the judgment matrix that is using for reflecting the relevant important degree of the internal indices the dominated index sets (the head). Finally via solving and combining the weight vector of judgment matrix to get the influence matrix between two indices sets. For example, the teaching content design index sets are dominating to the multi-media courseware making, so let every indices of $A_1$ as control standard firstly. Then according to those standards judge the relevant important degree of every index of $A_2$. On the basic of constructing and solving judgment matrix we could get the influence matrix between the index sets of $A_1$ and $A_2$ by combining their weight vectors. Finally, follow the specific order to combine the internal dependent matrices and influence matrices we could get the hypermatrix which is used for solving objective weights.

**Step 3:** Using the relevant important weights of indices set to construct weighting hypermatrix. Once a time, treating the index sets $A_i$, $B_i$, $C_j$ ($i=1,2,3$) as the control standards, aim at their index sets that has been influenced, constructing multiple comparison matrix which could reflect the relevant important degree between index sets. Then using the characteristic root method find out the relevant important weight that is corresponding with other index sets. Let the relevant important degree weights melt into hypermatrix could get the column normalized weighted hypermatrix (or column random matrix, as Table 1 shows).

**Step 4:** Obtaining the objective weights for weighted hypermatrix. Because of the weighted hypermatrix is stochastic matrix and has the global comparability, through calculating its limit could get the stable weight that can reflect the objective weights of interaction effects between the indices of multi-media teaching. Supposing the objective weight be $oa_y$, $ob_y$, $oc_y$ ($oa_y > 0$, $ob_y > 0$, $oc_y > 0$: $oa_y + ob_y + oc_y = 1$ ; $i, j =1,2,3$), which are corresponding with indices $A_i$, $B_i$, $C_j$ ($i, j =1,2,3$).

What need to be emphasized is integrating the subjective and objective weights confirmed by using the methods above and the evaluation information given by subjects could get the comprehensive value of multi-teaching. According to the comprehensive value could array the effects of multi-media from the best to the worst. Supposing there is N multi-media teaching course need to be evaluated. For the course NO.x, the evaluation information given by teachers and experts in teaching preparing phase are $XA_{n-1}(i, j)$ and $X_{n-2}(i, j)$ . The evaluation information given by teachers, students and experts in teaching implement phase are $XB_{n-1}(i, j)$, $XB_{n-2}(i, j)$ and $XB_{n-3}(i, j)$ . The evaluation information
given by teachers and students in teaching feedback phase is

\[ X_{C_{ij}}(i,j) \quad i,j = 1,2,3, \quad n = 1,...,N \]. Especially, during the evaluation process there might be lots of experts and students. For the sake of guarantee the objectivity and fairness, the experts and the students will be treat as equally important. Thus, the arithmetic average of their evaluation information should be

\[ X_{Bi_j}(i,j) \text{ or } X_{Si_j}(i,j) \]. In view of subjective and objective weights and index evaluation information, the calculation formula of the comprehensive value \( Z_{c} \) of all-round multi-media teaching is as below:

\[
Z_{c} = \sum_{i=1}^{n} \left[ (X_{A_{i_j}}(i,j) \times s_{A}) + X_{A_{i_j}}(i,j) \times s_{A} \right] \times \alpha_{A} + \sum_{i=1}^{n} \left[ X_{B_{i_j}}(i,j) \times s_{B} + X_{B_{i_j}}(i,j) \times s_{B} + X_{B_{i_j}}(i,j) \times s_{B} \right] \times \alpha_{B} + \sum_{i=1}^{n} \left[ X_{C_{i_j}}(i,j) \times s_{C} + X_{C_{i_j}}(i,j) \times s_{C} \right] \times \alpha_{C}, \quad n = 1,...,N
\]

Figure 3. All-round evaluation analyzing construction of multi-media teaching

V. A NUMERICAL EXAMPLE

Suppose there are three lessons X, Y and Z of multi-media teaching need to be evaluated comprehensively. Using brain-storming method or nominal group technology for confirming the subjective weights of teachers, students and experts in different phases (as is shown in TABLE II, line 2 to line 4). According to the system analyzing construction as shown in Fig.3, we could confirm the 27 indices objective weights in the bottom level (as is shown in TABLE II, line 5). In this process, we need to obey the process of constructing the hypermatrix by system analyze, constructing the weighted hypermatrix through the relevant important weights of index sets and get the objective weights by calculating the limit of the weighted hypermatrix (For the limitation of article length, here we only give the weighted hypermatrix, as TABLE I shows). Then the teachers, students and experts give their evaluation information of different phases according to hundred-mark system principle (as is shown in TABLE II, line 6 to line 14). Based on the information above, according to the calculating formula before, we could get the comprehensive evaluation value of these three lessons (in proper order are 86.6, 89.9 and 90.4). By the comprehensive evaluation value we could sum up, lesson Z has the best teaching effect, lesson Y is in the middle and lesson X is the worst in the teaching effect. The solving process and imitating results of the numerical example indicate that the method of article is feasibility in application

VI. CONCLUSIONS

This article puts forward the all-round evaluation system of multi-media teaching from objective factors design, subjective factors choosing and subjective-objective factors integration. On the basis of this system, we construct the empowerment an integration method of subjective and objective weights of all-round multi-media teaching evaluation. Finally, we prove the feasibility of this method by a numerical example. The method of this article could reflect comprehensive effects of multi-media teaching systematically and omni-directionally. At same time, this method could overcome the defections in scientificalness and efficiency of traditional methods for the reasons as below. Firstly, constructing evaluation indices system from the all-round angle of multi-media teaching is advantage of reflecting the whole effects of multi-media teaching, and also advantage of establishing foundation of obeying the Trinity principle of evaluation subjects. Secondly, the process of picking up and integrating the information of relevant evaluation subjects- teachers, students and experts- could achieve the goal of evaluating multi-media teaching comprehensively. The fairness of evaluation process could be guaranteed. Finally, by using the qualitative method such as brain-storming, nominal group technology and so on is advantage of guaranteeing the

© 2013 ACADEMY PUBLISHER
allowing the acceptability of weighting information. By using ANP method to confirm the objective weights could solve the problems such as the quantity and the styles of objective factors are numerous, the relationships between index and index are complex. Which need to be emphasized is as below. (1) This article is emphasis on constructing the general weighting method of subjective and objective weights, the teaching competent departments could work out their own subjective and objective weights by using this method and combine their policy demanding. (2) Although this article has constructed a whole evaluation method of multi-media teaching, the value of this article is more than this. Under the theoretical frame, we could derive a series of topics that deserve to be researched, such as picking up the efficient evaluation information of subjects, the assignment of subjective and objective weights under the uncertainty conditions, the comprehensive integration of evaluation information under uncertainty conditions and so on.

**TABLE I.**

<table>
<thead>
<tr>
<th>Subjective and Objective Weights and Their Evaluation Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjective weights</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>teachers</td>
</tr>
<tr>
<td>0.40</td>
</tr>
<tr>
<td>0.40</td>
</tr>
<tr>
<td>0.40</td>
</tr>
<tr>
<td>0.40</td>
</tr>
<tr>
<td>0.40</td>
</tr>
<tr>
<td>0.20</td>
</tr>
<tr>
<td>0.20</td>
</tr>
<tr>
<td>0.20</td>
</tr>
<tr>
<td>0.20</td>
</tr>
<tr>
<td>0.20</td>
</tr>
</tbody>
</table>

**ACKNOWLEDGEMENTS**

This work is supported by National Natural Science Funds (71261011), China Postdoctoral Science Foundation Funded Project (20110491760), Application of Basic Research Project in Yunnan Province (2011F2021), Key Project of Educational Commission in Yunnan Province (2012Z2103), Prophase Research Project of Yunnan Modernization Management and New Industrialization Research Base (YNXXJD201101), Kunming University of Science and Technology Reforming Project “Economics Public Foundation Course Teaching Team”(1096), and Kunming University of Science and Technology Organizational Behavior and Complex Behavior Decision-making Innovation Team Supported Project.

**REFERENCES**


Hongjuan Yang is a professor now at faculty of management and economics, Kunming University of Science and Technology. Her current research interests include supply-chain management, human resources management and so on.

Wanchun Duan received the Master degree of management from Kunming University of Science and Technology, Kunming, Yunnan Province, in 1995, and Bachelor degree in engineering from Kunming University of Science and Technology, in 1982. He is the president, professor and Doctor tutor now at faculty of management and economics, Kunming University of Science and Technology. His current research interests include organizational behavior, human resources management and so on.

Yuanwei Du received the Ph.D. degree in management from Jilin University, Changchun, Jilin Province, in 2010, and Master degree in management from Jilin University, in 2007, and Bachelor degree in management from Jilin University, in 2004. He is an associate professor and a mater tutor now at Kunming University of Science and Technology, Yunnan Province, China. His current research interests include management decision, information fusion, and so on.

Chen Han received the Bachelor degree in management from Beijing Sport University, Beijing, in 2010. She is working toward the Master degree in logistics engineering in Kunming University of Science and Technology, Yunnan province, China. Her current research interests include management decision, information fusion and so on.