Journal of Theoretical and Applied Information Technology
10th January 2013. Vol. 47 No.1

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

RESEARCH ON GRAY APPRAISAL MODEL OF MCAI SOFTWARE

GU ZHENLI

Guangdong Polytechnic Normal University， Guangzhou 510260

ABSTRACT

This paper analyzes the quality factors that influence the MCAI software, and builds a MCAI software index system. Determine the relative importance weights with the help of the 0～4 rating method, which avoid the determinacy of the appraisal index only on the qualitative analysis and value judgment of one expert in the analytic hierarchy process. We employ lots of experts's experience to determine the MCAI software appraisal index, thus the determinacy of appraisal index will be more objective and scientific. Meanwhile, the gray appraisal theory is applied in the MCAI software appraisal, and the gray appraisal model of MCAI software is build. The qualitative evaluation of MCAI software is transformed into quantitative analysis, which is the innovation of the MCAI software appraisal method.

Keywords: *MCAI Soft; Appraisal index system; Gray theory; Appraisal Model*

1. INTRODUCTION

Reference [1] presents the MCAI software appraisal system and the determinacy of appraisal index on the basis of AHP appraisal model. However, it's difficult to exclude the deviations that caused by the human factors such as personal preference, knowledge level, cognitive ability, etc merely based on the one expert's qualitative analysis and value judgment when we make evaluation of the index weight. It leads to the uncertainty, imperfect of assessment information, namely, the grayness, which also means that it is hard to make a reasonable qualitative analysis. Therefore, this paper improves the appraisal index weight method of MCAL software, and determines the relative importance weight with the help of 0～4 rating method. What's more, it avoids the qualitative analysis and value judgment merely based on one expert. Then it synthesizes the qualitative analysis and value judgment of experts, and applies the gray system theory in the MCAI software appraisal, builds the gray appraisal model of MCAI software. At the same time, the qualitative evaluation of MCAI software is transformed into qualitative analysis, which is the innovation of the MCAI software appraisal method.

2. MCAI SOFTWARE APPRAISAL INDEX SYSTEM

MCAI software possesses certain peculiarity while compared with general software. MCAI software is the special software that used in the teaching activities. It possesses not only the requirements like education and the technology aspect of general software, but also the requirements like education ability and psychology ability etc. This paper analyzes the factors that influenced MCAI software, and sets up MCAI software appraisal index system as shown in Figure1,

Figure 1 MCAI Software Appraisal Index System[1]

First class index	Second class index
Education Requirements（U_1）	Teaching aims（U_{11}） Teaching content（U_{12}） Teaching methods（U_{13}） Teaching tool （U_{14}）
Technical Requirements（U_2）	Reliability（U_{21}） Maintainability（U_{22}） Fault tolerance（U_{23}） Expandability（U_{24}）
Learning Psychology（U_3）	The principle that suit programmed instruction（U_{31}） Corresponding to cognitive psychology （U_{32}） Corresponding to psychology development（U_{33}）
Capacity Requirements（U_4）	Practical ability（U_{41}） Creativity ability（U_{42}） Problem solving ability（U_{43}）
User interface（U_5）	User- friendly（U_{51}） General and simple（U_{52}） Consistent form（U_{53}）

1 Foundation item: He nan natural science basic research plan item（2007520044）, Guangdong natural science basic research plan item (8151063301000012)

Journal of Theoretical and Applied Information Technology
10th January 2013. Vol. 47 No.1

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

3. APPRAISAL MODEL FOR MCAI SOFTWARE

Specialist appraised various indexes in Figure1 based on the designed MCAI software index system; the appraisal process is closely associated with the qualitative analysis and value judgment, so it's hard to completely exclude the deviations from human factors such as the personal preference, knowledge level, and cognitive ability, which lead to the uncertainty, imperfect of the assessment information, namely grayness. It means that it is difficult for the general systematic method to give a reasonable and quantitative analysis. Therefore, this paper appraised the MCAI software with the help of gray system theory, which aims to provide the reference for improving development quality of the MCAI software.

3.1 Appraisal Index Set

Based on the above appraisal index set: $U=\{U_1, U_2, U_3, U_4, \cdots, U_m\}$ ("m" is the number of first class index, m=5 in this pape), $U_k=\{U_{k1}, U_{k2}, U_{k3}, U_{k4}, \cdots, U_{kn}\}$ (n is the number k for second class index, for example, k=2 , n=4)

3.2 The Determinacy Of Appraisal Index

In multi – level index system, each level's influence on the above index is presented by weight, and weight size. This paper determine these relative importance weight by 0～4 rating method, the specific procedure presents as follows,

① The designed rating scale of experts presents as Figure 2, the experts' score

Figure 2 Weight Score Chart

Index	U_1 U_2 ---- U_n	Score
U_1 U_2 ⋮ U_n		C_1 C_2 ⋮ C_n

Rating method; Compare the indexes in the form of two, rating very important one for 4 points, not important one for 0 point, relative important one for 3 points, less important one for 1 point, both equally important for 2 points. , C_i is the sum for number 's compared score with other indexes

Rating method, make a paired comparison of several indexes, rating very important one for 4 points, relative important one for 3 points, both equally important for 2 points. C_i is the sum for number 's compared score with other indexes. 0～4 rating score can be divided as $\sum_{i=1}^{n} C_i = 2n(n-1)$, "n" is the index number, and the index U_i 's weight is $C_i / \sum_{i=1}^{n} C_i$ in U, namely, $C_i /2n(n-1)$.

② Suppose there is M experts gave mark on it, number J expert's score on number J is C_{ij}(j=1,2,⋯,m),calculate the score Z of each index $Z_i = \sum_{j=1}^{m} C_{ij}$ i=1,2,⋯,n.

③ Total score calculation

$Z=2mn(n-1)$

④ Indexes weights calculation

$a_i = Z_i / Z$

According to the above methods, experts are organized to mark the each index in the appraisal index of MCAI model, and calculate it, and then we can get the importance weight of the each index that compared with the previous one. Suppose the appraisal index Uk's weight set is $A=\{a_1,a_2,\cdots,a_m\}$, a_k stands for the weight of appraisal U_k in U, and $\sum_{k=1}^{m} a_k=1$; Meanwhile, suppose weight set of each second class index is : $A_k=\{a_{k1},a_{k2},\cdots,a_{kn}\}$, a_{ki} （i=1,2， ⋯n）represents the weight of index U_{ki} in U_k,, and $\sum_{i=1}^{n} a_{ki}=1$.

3.3 Confirm The Scoring System Of Index

The appraisal indexes are divided into different levels according to different degree, and then assign value to each degree. This paper divides the degree of appraisal indexes into four grades, and the assigned value is （10，8，6，4）. If the index grade locates between the two adjacent grades, the corresponding mark is 9，7，5，2 point.

3.4 Organize The Evaluators Scoring And Build The Appraisal Matrix D

Suppose the number of evaluators is S, the number of evaluators is h=1,2,3, ⋯s. Rating each index according to the above expert's rate criteria in the appraisal index system of MCAI software. List one expert's grade, S number of experts grade on the same index as line, and then builds the appraisal matrix D.

Journal of Theoretical and Applied Information Technology
10th January 2013. Vol. 47 No.1

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

$$D=\begin{pmatrix} d_1^{\,1}{}_1 & d_1^{\,2}{}_1 & \cdots & d_1^{\,h}{}_1 & \cdots & d_1^{\,s}{}_1 \\ d_1^{\,1}{}_2 & d_1^{\,2}{}_2 & \cdots & d_1^{\,h}{}_2 & \cdots & d_1^{\,s}{}_2 \\ \cdots & & & & & \\ d_k^{\,1}{}_i & d_k^{\,2}{}_i & \cdots & d_k^{\,h}{}_i & \cdots & d_k^{\,s}{}_i \\ \cdots & & & & & \\ d_m^{\,1}{}_n & d_m^{\,2}{}_n & \cdots & d_m^{\,h}{}_n & \cdots & d_m^{\,s}{}_n \end{pmatrix}$$

3.5 Seek Gray Evaluation

Suppose gray evaluation is P category. According to the grade that adopted in this paper, the grade is divided into 4 kinds, and here P=4, namely, suppose gray j=1, 2, 3, 4. These figures represent 4 gray evaluations. Each gray evaluation and white function shows as follows

The first kind （j=1）Superior, the score is 10 points or more than 10 points, the white function is f_1.

$$f_1=\begin{cases} 1 & d_k^{\,h}{}_i \geqslant 10 \\ d_k^{\,h}{}_i/10 & 0 \leqslant d_k^{\,h}{}_i < 10 \\ 0 & d_k^{\,h}{}_i < 0 \end{cases}$$

The second kind （j=2）: Good, the score is 8 points or so, the white function is f_2

$$f_2=\begin{cases} (16- d_k^{\,h}{}_i)/8 & 8 \leqslant d_k^{\,h}{}_i < 16 \\ d_k^{\,h}{}_i/8 & 0 \leqslant d_k^{\,h}{}_i < 8 \\ 0 & d_k^{\,h}{}_i < 0 \text{ or } d_k^{\,h}{}_i > 16 \end{cases}$$

The third kind （j=3）Qualified, the score is 6 points or so, the white function is f_3:

$$f_3=\begin{cases} (12- d_k^{\,h}{}_i)/6 & 6 \leqslant d_k^{\,h}{}_i < 12 \\ d_k^{\,h}{}_i /6 & 0 \leqslant d_k^{\,h}{}_i < 6 \\ 0 & d_k^{\,h}{}_i < 0 \text{ or } d_k^{\,h}{}_i > 12 \end{cases}$$

The fourth kind （j=4）Disqualified, the score is 4 points or less than 4 points, the white function is f_4

$$f_4=\begin{cases} (8- d_k^{\,h}{}_i)/4 & 4 \leqslant d_k^{\,h}{}_i < 8 \\ 1 & 0 \leqslant d_k^{\,h}{}_i < 4 \\ 0 & d_k^{\,h}{}_i < 0 \text{ or } d_k^{\,h}{}_i > 8 \end{cases}$$

3.6 Calculate The Gray Evaluation Coefficient

The appraisal index U_{ki} is the number j gray evaluate coefficient of gray evaluation, marked as $x_k^{\,j}{}_i$, then we get $x_k^{\,j}{}_i = \sum_{q=1}^{s} f_j(d_k^{\,q}{}_i)$, the appraisal index U_{ki} is the general gray evaluation coefficient of each gray evaluation, marked as x_{ki}, then we get

$$x_{ki} = \sum_{j=1}^{p} x_k^{\,j}{}_i$$

3.7 Seek Gray Evaluation Weight Vector And Weight Matrix

S estimators tend to regard appraisal index U_{ki} as gray evaluation weight of number j, and marked $r_k^{\,j}{}_i$, then $r_k^{\,j}{}_i = x_k^{\,j}{}_i / x_{ki}$. Owing to the P gray evaluation, namely, j=1,2, …,p. S evaluators tend to regard appraisal index U_{ki} as the gray appraisal vector of each gray evaluation, $r_{ki}=(r_k^{\,1}{}_i, r_k^{\,2}{}_i, \cdots, r_k^{\,p}{}_i)$. Synthesize gray appraisal weight vectors of all the appraisal index U_{ki} rk_i（i=1,2, …,n, namely, the index, U_{ki} of U_k, and the gray appraisal weight vector of gray evaluation R_k:

$$R_k=\begin{pmatrix} r_{k1} \\ r_{k2} \\ \vdots \\ r_{kn} \end{pmatrix} = \begin{pmatrix} r_k^{\,1}{}_1 & r_k^{\,2}{}_1 & \cdots & r_k^{\,p}{}_1 \\ r_k^{\,1}{}_2 & r_k^{\,2}{}_2 & \cdots & r_k^{\,p}{}_2 \\ & \vdots & & \\ r_k^{\,1}{}_n & r_k^{\,2}{}_n & \cdots & r_k^{\,p}{}_n \end{pmatrix}$$

3.8 The Comprehensive Evaluation Of U_k

$B_k = A_k \cdot R_k = (b_{k1}, b_{k2}, \cdots, b_{kp})$, B_k represents S evaluators' gray appraisal weight vector of index. B_{kj}（j=1,2, …,p）indicates S evaluators tend to regard U_k as the j gray appraisal weight.

3.9 The Comprehensive Evaluation Of U

According to the comprehensive assessment result of U_k, B_k, we can inform that U belongs to the gray appraisal matrix of each gray evaluation, R :

$$R=\begin{pmatrix} B_1 \\ B_2 \\ \vdots \\ B_m \end{pmatrix} = \begin{pmatrix} b_{11} & b_{12} & \cdots & b_{1p} \\ b_{21} & b_{22} & \cdots & b2_p \\ & \vdots & & \\ b_{m1} & b_{m2} & \cdots & b_{mp} \end{pmatrix}$$

And then make a comprehensive assessment on U, the assessment result,

$$B=A\cdot R=(a_1,a_2\cdots a_m)\cdot \begin{pmatrix} b_{11} & b_{12} & \cdots & b_{1p} \\ b_{21} & b_{22} & \cdots & b_{2p} \\ & \vdots & & \\ b_{m1} & b_{m2} & \cdots & b_{mp} \end{pmatrix}$$

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

$=(b_1,b_2,\cdots,b_p)$

b_j（j=1,2, ⋯,p）indicates U belongs to number j gray evaluation weight.

According to maxim membership degree, we can ascertain the gray evaluation grade j that U belongs to, namely, $b_j^* = \max_{1\le j\le p}$（$b_j$）.

4. APPLICATION OF APPRAISAL MODEL

4.1 Determine The Weight Of Each Index In Appraisal Index System Of MCAI

Experts are organized to rate the each index in figure 1 according to the method in figure 2, and the calculate method of index weight, the relative weight of general object in first layer index A= {0.42，0.13，0.18，0.16，0.11}；the weight of second layer compared with first layer, ： A_1= {0.27，0.22，0.26，0.25}，A_2= {0.30，0.27，0.23，0.20}，A_3= {0.37，0.32，0.31}， A_4= {0.38，0.32，0.30}，A_5= {0.41，0.35，0.24}。

4.2 Make An Evaluation On Mcai Software Of Linear Algebra With The Help Of Appraisal Model

Six experts are organized to make an evaluation on MCAI software of linear algebra according to 17 indexes in the appraisal index set of figure 1, and fill the evaluation form, build the appraisal vector. Make an evaluation on the MCAI software with the help of above appraisal model, build the appraisal vector, and we get the appraisal result B＝ {0.1216，0.5403，0.3054，0.0327}.

According to the maximum attribute degree⑩, $b_j^* = \max_{1\le j\le 4}$（$b_j$）=0.5403, so the appraisal result of the model is “good”.

5. CONCLUSION

This paper makes an analysis on the quality factors of MCAI software, and builds the appraisal index system of MCAI software. And determine the appraisal model of MCAI with help of 0～4 rating method which including many experts’ experience. Apply the gray system theory in the MCAI software appraisal, build the gray appraisal model of MCAI software, and the qualitative evaluation of MCAI software is transformed into quantitative analysis, which is the innovation of the MCAI software appraisal method. It can lead the software design’s development toward user’s requirements, and improve the quality development, on the other hand, it can promote the teaching reformation through the elevation of MCAI software.

REFERENCE

[1] Gu Zhenli . Research on Evaluation Model for Mcai Software Based on Improved Ahp [J]. Computer applications and software, 2008, (4) : 281-283

[2] Liu ShiFeng,Gu Tianpang, Dang Yaoguo.The grey system theory and its application[M]. Beijing, Science press,2004

[3] Gu Danglie. Journal full-text database professional correlation judgment gray clustering model [J]. Journal of information，2006,(2):127-128,131

[4] Xiao Qing,Wang shanhu,Xiao Jun. Based on the fuzzy ahp, the comprehensive evaluation of the network information resources[J]. Journal of Information，2006,(3):63-65

[5] Xu Shi, WangYingLin. Grey system theory in the patent forecast analysis research and application [J]. Computer application and software, 2006, (4) : 126-128

[6] Gu Zhenli .Research on an Evaluation Model of the MCAI Software Based on the Improved Entropy Method [J]. Computer Engineering & Science, 2010,32(7):134-136

[7] Gu Zhenli .Evaluation model of principal component analysis of MCAI software[J]. Computer Engineering and Design,2011, 32(7) : 2398-2401

[8] LiuLiPing, ChenZhiGang.A kind of supplier selection and evaluation model[J]. Micro computer information，2008，24(15):17-18

[9] LouYaFang. Multimedia computer-aided teaching courseware evaluation system and production[J]. computer generation,2007, (3): 65-66

[10] PengGuangHui, ShenWeiHua, TangHui. Constructing the sports technology curriculum multimedia CAI courseware evaluation system and standard research[J]. Sports science, 2007,(24):51-53

[11] JiYuBin, LiGuoFang, JiaBaoQin. Web page type multimedia CAI courseware evaluation system[J]. Education informatization,2005(3): 54-56

[12] JinCong .CAI courseware comprehensive evaluation research[J]. Computer engineering. 2002,29(3):237-239