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## **Research and design of learning evaluation system of university students based on j2ee and fuzzy AHP**

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### **ABSTRACT**

Evaluation is indispensable for education. Faced with network education which has become a trend, traditional evaluation has shown its weakness. To have easier and more accurate evaluation of student's learning process and result, evaluation model and algorithm was established with AHP and fuzzy theory as the key. Research and design of the system was conducted using J2EE and B/S structure. The system was confirmed to be easier and more scientific concerning evaluation of students' learning.

### **KEYWORDS**

J2EE; Analytic hierarchy process; Fuzzy theory; Network education; Learning evaluation.



## INTRODUCES

As feedback and readjusting mechanism of learning system, learning evaluation is of great importance in the process of learning and teaching and has always been a key research subject for educators and psychologists. With the development of network technology, computer technology, education theory and practice, network teaching system has been established in many universities. This teaching mode impacts traditional means of education and presents challenge to traditional means of evaluation. Education evaluation mainly includes quantitative evaluation and non-quantitative evaluation<sup>[1]</sup>. The former performs nice in evaluating students' knowledge and IQ, but doesn't work in evaluating students' learning attitude, motive and interest. Fuzzy theory<sup>[2]</sup> and Analytic hierarchy process (AHP)<sup>[3]</sup> is introduced here as means of evaluation. Learning evaluation system of university students under network learning mode is researched and designed using J2EE technique. This system combines quantitative and non-quantitative evaluation together and truly reflects real information and makes evaluation easier and more scientific.

## INTRODUCES TO J2EE TECHNOLOGY

### J2EE Technology

J2EE is a system structure used to simplify enterprise development and deployment of solutions and to manage complex problems by using Java 2 platform. It's a kind of enterprise application system development specification based on Java component technology. It's compatible with different platforms, portable, retractable, flexible and easy to maintain.

J2EE adopts multilayer application mode and classifies into various components according to application of logic function. These application components are distributed among machines depending on which layers they are on. J2EE has four typical layers, namely, user layer component operated on user machine, business logic layer component operated on J2EE server, Web layer component operated on J2EE, and enterprise information system layer software operated on EIS server<sup>[4,5]</sup>

### B/S system structure

This system is developed based on browser/server system structure, the server port of which includes Web server and data base server. This structure has such advantages as simple system, powerful function, less pressure on server and ability in cross-regional operation. What's more, layer structure of the business logic is clearer, which is good for team development and enhances system extensibility and maintainability and makes connection between data bases easier. B/S structure using J2EE is shown in Figure 1.

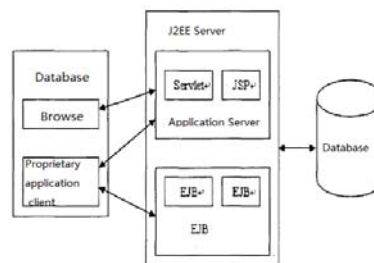


Figure 1 : B/S structure using J2EE

## INTRODUCES TO ANALYTIC HIERARCHY PROCESS AND FUZZY THEORY

### Introduces to Analytic hierarchy process

AHP created by Professor Saaty is a kind of analytical method which is systematical, analytical and combines qualitative and quantitative, involves quantitative analysis of non-quantitative events, it's

mainly used under uncertain situation and decision-making issues<sup>[6,7]</sup>. This method mainly includes the following procedures:

- (1) Defining the problem, finding out factors which influence the problem, analyze;
- (2) Establish layer structure model, no more than 7 factors for each layer;
- (3) Define initial variables, construct pairwise comparison matrix;
- (4) Calculate weight vector and conduct consistency check. Turn to (5) if consistency rate is under 0.1, otherwise, turn to (3);
- (5) Calculate weight vector and conduct consistency check. Define five-level variables for learning evaluation and output evaluation result.

This paper mainly discusses learning evaluation of university students receiving network education from four aspects, cooperation, communication, using of learning resources, learning attitude and performance<sup>[8,9]</sup>. Layer structure model constructed using AHP is shown in Figure 2<sup>[10]</sup>.

Calculation is done accurately and efficiently following the above five procedures using Matlab program. Synthetic weight of each index is shown in TABLE 1.

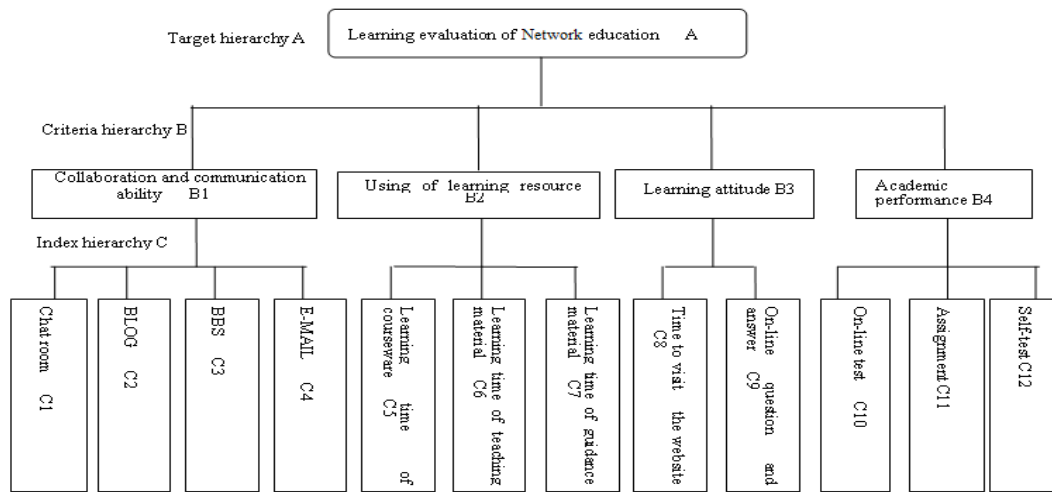


Figure 2 : Hierarchy structure for Network learning evaluation index

TABLE 1 : Synthetic weight of each index

Index hierarchy	B (1)	B (2)	B (3)	B (4)	Synthetic weight
C (1)	0.0838				0.015847
C (2)	0.3509				0.029405
C (3)	0.1091				0.009143
C (4)	0.3509				0.029405
C (5)		0.2970			0.040897
C (6)		0.5396			0.074303
C (7)		0.1634			0.0225
C (8)			0.3333		0.077426
C (9)			0.6667		0.154874
C (10)				0.5396	0.29473
C (11)				0.1634	0.089249
C (12)				0.2970	0.162221

Fuzzy theory is a general term of fuzzy topology, fuzzy measure theory which are developed on the basis of fuzzy set and fuzzy logic. It's a kind of mathematic theory used to research and deal with fuzzy phenomena. It's about approximate quantitative dealt with human expression based on fuzzy and inaccurate information. It emphasizes human thought, inference and degree of cognition to things around. Its concept is quite vague and the fuzziness described by this theory is about uncertainty in terms of degree of membership. However, it's able to describe fuzzy phenomena with accurate mathematic language. It represents an idea differs from traditional method dealing with uncertainty and inaccuracy and can better reflect fuzzy phenomena.

Fuzzy comprehensive evaluation method is adopted here. It's frequently adopted in combination with AHP. There're many factors to be considered in the process of evaluation and there's no exact indices. Weight coefficient can be obtained through AHP instead of traditional means which directly defines weight. TABLE 1 shows the weights of various factors obtained through AHP. Then fuzzy theory is adopted to establish evaluation index factor set and evaluation set and membership function.

### Establishment of evaluation index factor set and evaluation set

(1) Define primary index set as  $B = (B1, B2, B3, B4) = (\text{collaboration and communication ability, using of learning resources, learning attitude, performance})$ , and corresponding weight set as  $Bw = (B1, B2, B3, B4) = (0.0838, 0.1377, 0.2323, 0.5462)$ .

(2) Define secondary index set as  $C = (C1, C2, \dots, C11, C12) = (\text{chatting room, blog, \dots, homework, self-test})$ , and corresponding weight set as  $Cw = (C1, C2, \dots, C11, C12) = (0.1891, 0.3509, \dots, 0.1634, 0.2970)$ .

(3) Define fuzzy evaluation set as  $A = (a1, a2, a3, a4, a5)$ . Based on characteristics and requirements of network education system, fuzzy numbers must be used to replace grades used by teachers. By making use of the currently used five-grade evaluation mode which consists of excellent, good, medium, pass, fail, a grade score matrix  $G = (95, 85, 75, 65, 50)^T$  is established, as shown in TABLE 2.

TABLE 2 : Evaluation grades and corresponding scores

Range of score	Grade	Represented score
$90 \leq X < 100$	Excellent	95
$80 \leq X < 90$	Good	85
$70 \leq X < 80$	Medium	75
$60 \leq X < 70$	Pass	65
$X < 60$	Fail	50

### Membership function of fuzzy evaluation matrix

Rank all students based on their performance in a particular course. Classify the ranking sequence into five grades, namely  $(0\% \sim 10\%], (10\% \sim 30\%], (30\% \sim 60\%], (60\% \sim 90\%], (90\% \sim 100\%]$ . Students' ranking and their real level should meet normal distribution in a test. This is equivalent to defining a membership function by using fuzzy statistics method of degree of membership. We can use  $[0, 1]$  interval to measure indefiniteness. Based on degree of membership, if a student's rank rages within  $(10\% \sim 30\%]$ , then the possibility for his or her real level to fall within  $(10\% \sim 30\%]$  is 0.7 and 0.15 for  $(0\% \sim 10\%]$  and  $(30\% \sim 60\%]$ . Therefore, the student's real level in the class can be described with vector  $(0.15, 0.7, 0.15, 0, 0)^{[11,12]}$ .

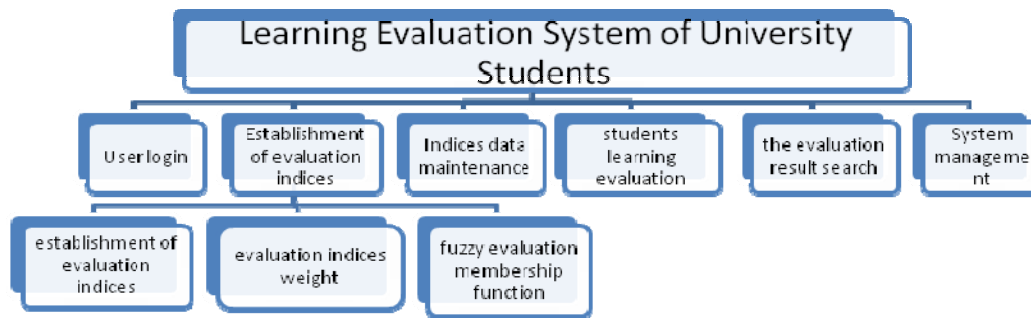
## SYSTEM DESIGN

### Function and structure of system

This system adopts function modularization in design and development with such main function modules as user login, establishment of evaluation indices, maintenance of index data, students learning

evaluation, evaluation result search and system management and setting module. Figure 3 shows function structure of students learning evaluation system.

(1) User login module verifies user and logging right thereof. If this user is valid, the system enters the right operating interface according to type of the user so the user can operate accordingly.



**Figure 3 : The function structure of students learning evaluation system.**

(2) Establishment of evaluation indices module includes sub-modules of establishment of evaluation indices, evaluation indices weight, and fuzzy evaluation membership function. This module is the core of the evaluation system and is realized mainly through AHP and fuzzy comprehensive evaluation in background. Establishment of sub-modules of evaluation indices involves establishment, editing, deletion, noting, etc. of evaluation indices, same as Step 1 and 2 of AHP operating steps in which layer structure model is established. For establishment of evaluation indices weight sub-module, weight of each index is calculated according to teachers' input and this is the same as step 3, 4 and 5 of AHP operating steps. Establishment of fuzzy evaluation membership function sub-module mainly aims at establishment of evaluation set and membership function.

(3) Indices data maintenance module involves entering, editing, deletion, sequencing of indices data. As the data is huge, it's usually stored in educational administration management system and can be entered into this system out of educational administration management system.

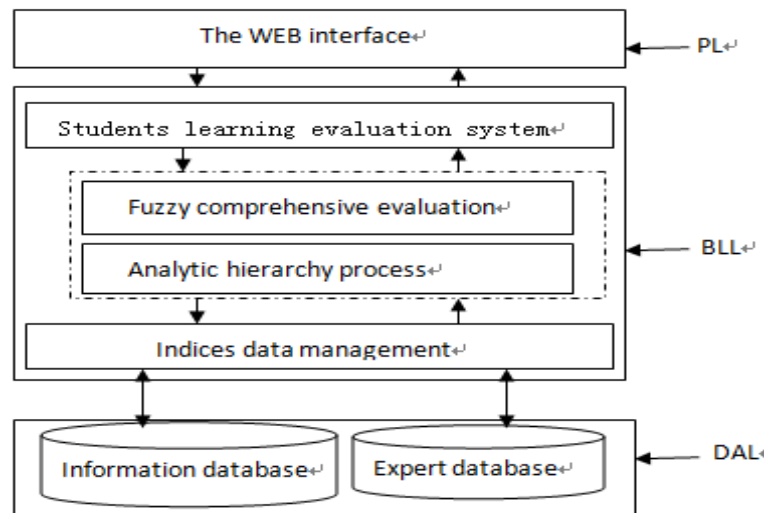
(4) In students learning evaluation model, comprehensive evaluation of students is conducted based on indices data and result is entered. This is usually done in unit of class or grade.

(5) In the evaluation result search module, result can be searched by individuals or classes and can be printed out.

(6) System management module is mainly designed for user management. Users fall into such types as administrator, teacher and student. The system administrator has the highest authority and is responsible for building users and granting them corresponding authority and system maintenance. Teachers can establish evaluation indices and maintain relevant data. Students can only check their evaluation results.

### System structure

Students learning evaluation system adopts B/S structure in development. This structure is divided into three layers in the way of logic, they are, from top to bottom, data access layer (DAL), business logic layer (BLL) and presentation layer. Figure 4 shows structure of Students learning evaluation system.



**Figure 4 : Structure of Students learning evaluation system**  
**CONCLUSIONS**

Targeting at students learning evaluation under network education, a students learning evaluation model that is reasonable, fair and accurate is proposed here based on AHP and fuzzy mathematics principles and simulation evaluation is given based on real cases. Then the system is analyzed and designed based on J2EE technique and B/S system structure. This system can better solve unscientific setting of evaluation indices weight and disability of students learning under network environment in a quantitative manner. It makes it possible to comprehensively calculate evaluation indices and combine quantitative evaluation with non-quantitative evaluation so as to get results that factual, considerably improves accuracy and reliability of evaluation results.

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