

## **FUZZY DECISION PROCESS IN PARENTAL SCHOOL CHOICE**

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*ABSTRACT. The main purpose of this research is to create strategies of school choices for educational quality of junior high school. We propose strategy for making decisions of school choices. Adopt the approach of quantized research, and select altogether 20 parents of two schools (School A & B) to participate in studying. First of all, this research establishes the expert's fuzzy weight of educational quality with the fuzzy theory. We apply the expert's fuzzy weight to discuss the parents' satisfaction to quality of school education which their children studied. Moreover, we use the method of fuzzy relative weight to analyze. Hope that could understand parents' feeling to the quality satisfaction of school education. Finally, propose the relevant suggestion according to the result of study.*

**Keywords:** Fuzzy Evaluation; Educational Quality; Parental School Choice

**1. Introduction.** In the globalization, marketization and pluralistic educational reform, various countries paid highly attention to improve educational quality. In the United States, within the impact of the educational marketization, the concept of educational vouchers is first proposed. The meaning of educational vouchers is to give parents studying costs to choose school for their children. It involves the improvement of school educational quality. The people all pay much attention to the competition among the schools. The focus of educational reform is educational quality of the school (Belfield & Levin, 2002). In other words, educational quality is the key factor in competitiveness of schools, educational quality is very important. In conclusion, school needs to constantly pursuit of improving the quality of education, deal with the trend of educational reform and raise effective strategies to respond to the educational market competition. Although the aspect of educational quality is extensive, we can sum up four aspects such as teacher, administration, environment and curriculum according to literature research (Culver, 2010; The Louisiana Association of Education, 2005; Yang & Chen, 2010).

The concept of educational quality has changed the thinking of parental educational option. As we know, educational quality is an important basis for choice of schools. In 1948, the third item of Article 26 of the Universal Declaration of Human Rights explicitly stated that the parent has the priority right to choose education for their children (Liu, 2000). Most of the modern countries, such as United States, Britain and Australia etc, have viewed the parents' educational option as one of the crucial policy of the educational reform, in order to enhance educational quality of schools. Consequence of this, most of the modern nations has viewed education option as an important issue of education reform. Since the policy of educational option is implemented, this issue continues without interruption. Education option has become a popular research theme in the field of education (Kahlenberg, 2003; Peterson, 2001; Qin, 2002).

Analyze the education and psychology from the view of probability statistics is a shortened form in mathematics way. When data are expressed in our natural language, they are fuzzy. Moreover, in human logic and recognition, the thinking behavior perceived is fuzzy and ambiguous, these processes often ignore these (Nguyen & Wu, 2006; Wu, 2005). Because it is very difficult for us to define educational quality accurately, we must set up the indicator aspect of the educational quality of school at first. In this research, we apply fuzzy statistics to develop a tool of study. We study the junior middle school student parents by questionnaire investigation, in order to establish a in the educational option.

The purpose of this research is narrated as follows: 1. Understand what parents would concern when making decisions in the educational option. 2. Utilize fuzzy theory to establish strategies of fuzzy decisions in the educational quality.

## **2. Research Methods.**

**2.1. Research methods and procedures.** This research utilizes investigation method of the questionnaire and fuzzy evaluation, hope to establish equation of fuzzy evaluation of selecting a school. The evaluation procedure mainly includes three parts, such as goal, contents, method and fuzzy decisions (as shown in Figure 2.1). First of all, this research aims at the strategies of parents' educational option. We sum up four aspects of educational quality according to the literature, for instance teacher, administration, environment and curriculum etc. Secondly, collect realistic data from samples, namely, from parents' points of view. Thirdly, the research approach is to compile the questionnaires of parents' educational option. We collect altogether 20 of parents of two junior high schools(Turn name into A and B school) 6 participants are deleted because of useless answering. The efficient percentage of participants is 70%. Finally, sum up the result of study.

**2.2. Why we use fuzzy statistics.** Since fuzzy theory is generated by Zadeh (1965), the application in every research field of fuzzy statistics grows vigorously like the mushrooms after rain. It regards fuzzy logic as theoretical foundation, and extend the logic concept of the two- values logic of traditional mathematics, break through the limitation thinking of binary logic way. Just as the fuzzy statistics scholar's concern, the human thinking can't be measured or described with the single option. In other words, it should has membership of each option revealing its relative importance (Law, 1997; Nguyen & Wu, 2006; Wu, 2005).

Different from the traditional quantized questionnaire, the fuzzy questionnaire can reflect possibility and feasibility of the human fuzzy thinking specialty even more. (As shown in Table 2.1) Because in human thinking and behavior, nearly reflect the fuzziness of things, languages shown are all fuzzy languages too (Wu, 2005). Apply the fuzzy logic to the analysis of questionnaire investigation, offer a novel idea of collecting and analyzing data, it's a concept of fuzzy theory which allow people to have multiple experiences(Jiang, Wu & Hu, 2008).

Relative to traditional data, we can not only know the finally option, but also the fuzzy thinking of participant in fuzzy data. In other words, the participant's preference is reflected more accurately in fuzzy voting.

TABLE 2.1. The Example of Responding Fuzzy Questionnaire

aspect	Very low	Low	Medium	High	Very high
Teacher			3	3	4
Administration	2	6	2		
Environment					10
Curriculum				5	5

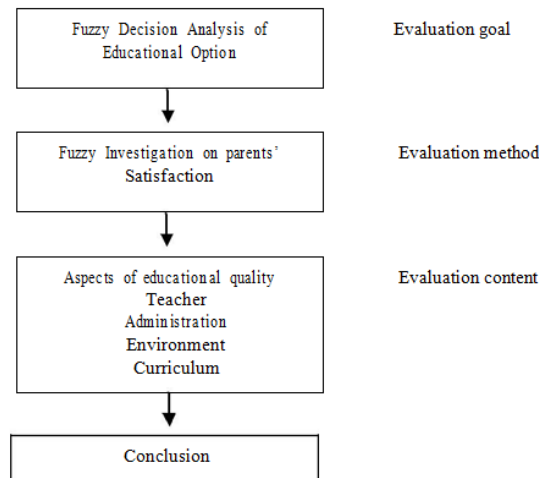


FIGURE 1. Flowchart for the evaluation process.

**3. Fuzzy Decisions.** Related concepts of fuzzy statistics using in this paper are illustrated as follows:

### 3.1. Fuzzy relative weight.

Definition 3.1 Fuzzy relative weight (*FRW*)

The fuzzy weight shows the self- weight of every factor. Main purpose of fuzzy weight analyze try to get fuzzy relative weight. We defined fuzzy relative weight for analysing fuzzy weight.

Consider universe of discourse  $S = \{S_1, S_2, \dots, S_k\}$ , utility sequence  $r = \{r_1, r_2, \dots, r_f\}$ , and

$\mu_{S_{ij}}$  is the membership of  $r_j$  in  $S_j$ . Then fuzzy relative weight  $FRW = (FRW_{S_1}, \dots, FRW_{S_k})$  is defined by evaluation criterion of  $m$  grade. If  $r = \{r_1, r_2, \dots, r_f\}$  is utility increasing

sequence  $r_1 \prec r_2 \prec \dots \prec r_f$ , then  $FRW_{S_i} = \frac{\sum_{l=1}^f l \cdot \mu_{S_{il}}}{i = \sum_{i=1}^k \sum_{l=1}^f l \cdot \mu_{S_{il}}}$ ,  $i = 1, \dots, k$ ; otherwise,

$$r_1 \prec r_2 \prec \dots \prec r_f \quad (2.1)$$

$$FRW_{S_i} = \frac{\sum_{l=1}^f (n-l+1) j \cdot \mu_{S_{il}}}{i = \sum_{i=1}^k \sum_{l=1}^f (n-l+1) \cdot \mu_{S_{il}}}, i = 1, \dots, k \quad (2.1)$$

**3.2. Calculate procedure of fuzzy relative weight.** We design Table 3.1 as fuzzy evaluation table to calculate fuzzy relative weight. Let  $r_1, r_2, \dots, r_f$ , then the fuzzy weight of factor is defined.

$$\begin{aligned} FW_{S_1} &= \sum_{l=1}^f \mu_{S_{1l}} / r_l = \mu_{S_{11}} / r_1 + \mu_{S_{12}} / r_2 + \dots + \mu_{S_{1f}} / r_f \\ FW_{S_2} &= \sum_{l=1}^f \mu_{S_{2l}} / r_l = \mu_{S_{21}} / r_1 + \mu_{S_{22}} / r_2 + \dots + \mu_{S_{2f}} / r_f \\ FW_{S_k} &= \sum_{l=1}^f \mu_{S_{kl}} / r_l = \mu_{S_{k1}} / r_1 + \mu_{S_{k2}} / r_2 + \dots + \mu_{S_{kf}} / r_f \end{aligned} \quad (3.1)$$

TABLE 3.1. Fuzzy evaluation.

	$r_1$	$r_2$	$\dots$	$r_f$
$S_1$	$\mu_{S_{11}}$	$\mu_{S_{12}}$	$\dots$	$\mu_{S_{1f}}$
$S_2$	$\mu_{S_{21}}$	$\mu_{S_{22}}$	$\dots$	$\mu_{S_{2f}}$
$\dots$	$\dots$	$\dots$	$\dots$	$\dots$
$S_k$	$\mu_{S_{k1}}$	$\mu_{S_{k2}}$	$\dots$	$\mu_{S_{kf}}$

Ps.  $r$   $\mu_A$  is membership of  $A$  in utility sequence  $r$

Utilize  $m$  grade evaluation criterion calculate fuzzy relative weight  $FRW$  of each factor. Meaning of  $m$  grade evaluation criterion is that utility sequence  $r$  is regarded as  $f$  grade, fetch the quantity to this  $f$  grade. That is to say, let the value of  $r_1$  is one ( $r_1 = 1$ ),  $r_2$  is two ( $r_2 = 2$ ), and then  $r_f$  is  $f$  ( $r_f = f$ ). Then

$$FRW_{S_1} = \frac{\sum_{l=1}^f l \cdot \mu_{S_{1l}}}{i = \sum_{i=1}^k \sum_{l=1}^f l \cdot \mu_{S_{il}}}, FRW_{S_2} = \frac{\sum_{l=1}^f l \cdot \mu_{S_{2l}}}{i = \sum_{i=1}^k \sum_{l=1}^f l \cdot \mu_{S_{2l}}}, \dots, FRW_{S_k} = \frac{\sum_{l=1}^f l \cdot \mu_{S_{kl}}}{i = \sum_{i=1}^k \sum_{l=1}^f l \cdot \mu_{S_{kl}}} \quad (3.2)$$

**3.3. Strategy: emphasize one certain aspects.** Let  $X$  be the universe set,  $X = \{X_1, X_2, \dots, X_n\}$ , and

$X_i$  be a variable on  $X$ . The relative importance of  $X_i$  is higher than the other variables. The fraction that focus on  $X_i$  is viewed as  $S(X_i)$ , then the fuzzy multiple decisions for emphasis on a certain aspect is defined as:

$$S(X_i) = X_i \left( \frac{\sum_{i \neq i, i=1}^n X_i}{n-1} \right) \quad (3.1)$$

#### 4. Empirical Analysis.

**4.1. Fuzzy relative weight of educational quality: calculation of membership grade of expert.** We establish fuzzy relative weight of educational quality from the membership grade of educational experts. We get the fuzzy weight from fuzzy data as follows:

$FW_{Teacher} = 0/\text{very low} + 0/\text{low} + 0/\text{medium} + 0.31/\text{high} + 0.75/\text{very high}$

$FW_{Administration} = 0/\text{very low} + 0/\text{low} + 0.31/\text{medium} + 0.30/\text{high} + 0.40/\text{very high}$

$FW_{Environment} = 0/\text{very low} + 0/\text{low} + 0.18/\text{medium} + 0.41/\text{high} + 0.43/\text{very high}$

$FW_{Curriculum} = 0/\text{very low} + 0/\text{low} + 0.01/\text{medium} + 0.40/\text{high} + 0.65/\text{very high}$

We give the value of utility sequence as very low =1, low= 2, medium=3, high=4 and very high= 5. The multiplier of membership and value of utility sequence is the fuzzy weight of every aspect. Then we calculate the fuzzy relative weight, as shown in Table 4.1.

The decreasing sequence of fuzzy relative weight is  $FRW_{Teacher}=0.273$ ,  $FRW_{Curriculum}= 0.267$ ,  $FRW_{Environment}= 0.235$  and  $FRW_{Administration}= 0.226$ . The difference of FRW of each aspect is not obvious.

The index of educational quality is defined as follows:

$$\text{Index}_{\text{Educational quality}} = 0.273 \times W_{Teacher} + 0.226 \times W_{Administration} + 0.235 \times W_{Environment} + 0.267 \times W_{Curriculum}$$

TABLE 4.1 Fuzzy relative weight of expert's membership of educational quality.

aspect	utility sequence					Fuzzy weight	Fuzzy relative weight
	very low	low	medium	high	very high		
Teacher	0	0	0	0.31	0.75	5	0.273
Administration	0	0	0.31	0.3	0.4	4.14	0.226
Environment	0	0	0.18	0.41	0.43	4.3	0.235
Curriculum	0	0	0.01	0.4	0.65	4.89	0.267

**4.2. The result on the fuzzy opinion of parents' satisfaction to educational quality: A, B two schools is examples.** Our samples are partents of School A and School B. We utilize Educational quality investigation of fuzzy Satisfaction. The satisfaction in every aspect is averaged as Table 4.2 after statistics. Thus we sequence fuzzy weight of parents of school A as Curriculum= 4.31, Teacher= 4.19, Environment= 3.69, and Administration= 2.87. Among them it is the highest with Curriculum satisfaction of course, the lowest in Administration satisfaction. Sequence fuzzy weight of parents of school school B as Administration= 4.37, Teachers= 4.19, Curriculum= 4.09, and Environment= 3.27. Among them it is the highest with Administration satisfaction, the lowest in Environment

satisfactions. In addition, the fuzzy value of education quality of School A and B, it is the School B = 3.9868 > School A = 3.3761.

TABLE 4.2. Fuzzy weight of single aspect and fuzzy fraction of educational quality.

aspect	school	utility sequence					Fuzzy weight	Fuzzy fraction of educational quality	sequence
		very low	low	medium	high	very high			
Teacher	A	0	0.09	0.14	0.27	0.5	4.19	3.3761	2
	B	0.03	0.11	0.47	0.86	2.71	4.19	3.9868	2
Administration	A	0.1	0.21	0.5	0.14	0.04	2.87		4
	B	0	0	0.43	1.37	2.57	4.37		1
Environment	A	0.1	0.06	0.2	0.34	0.3	3.69		3
	B	0.03	0.31	1.2	1.37	0.35	3.27		4
Curriculum	A	0	0.01	0.16	0.33	0.5	4.31		1
	B	0	0	0.64	1.94	1.5	4.09		3

**4.3. Analysis of strategy: emphasize one certain aspects of satisfaction of educational quality of patents.** We research 14 parents of School A and School B, in order to understand their satisfaction opinion of educational quality. The satisfaction average in

every aspect is shown in Table 4.3. According to 3.3 Strategy  $S(X_i) = X_i \left( \frac{\sum_{i \neq i, i=1}^n X_i}{n-1} \right)$  the value of emphasize one certain aspects is shown in Table 4.3. The computational process is shown as follows:

$$SX_{Teacher} = X_{Teacher} \cdot \frac{X_{Administration} + X_{Environment} + X_{Curriculum}}{3}$$

$$SX_{Administration} = X_{Administration} \cdot \frac{X_{Teacher} + X_{Environment} + X_{Curriculum}}{3}$$

$$SX_{Environment} = X_{Environment} \cdot \frac{X_{Teacher} + X_{Administration} + X_{Curriculum}}{3}$$

$$SX_{Curriculum} = X_{Curriculum} \cdot \frac{X_{Teacher} + X_{Administration} + X_{Environment}}{3}$$

Thus, from result of calculation we sequence value of fuzzy decisions of School A as Teacher= 15.76, Curriculum= 15.63, Environment= 14.13, and Administration= 11.61. Among them it is the highest with Teacher satisfaction, the lowest in Administration satisfaction. As shown in Table 4.3 In addition, we sequence value of fuzzy decisions of School B as Administration=16.82, Teacher= 16.18, Curriculum= 16.11, and Environment= 14.01. Among them it is the highest with Administration satisfaction, the lowest in Environment satisfaction. As shown in Table 4.3.

TABLE 4.3. Fuzzy decisions: Emphasize a certain aspects.

Strategy	school	value of fuzzy decisions	sequence	higher value
Strategy 1	A	15.76	1	
Emphasis on Teacher	B	16.18	2	⊙
Strategy 2	A	11.61	4	
Emphasis on Administration	B	16.82	1	⊙
Strategy 3	A	14.13	3	⊙
Emphasis on Environment	B	14.01	4	
Strategy 4	A	15.63	2	
Emphasis on Curriculum	B	16.11	3	⊙

Ps. The higher value is marked "⊙".

**5. Conclusion.** In this research we utilize fuzzy statistics to fuzzy decisions in the school choices, expect to be able to establish appropriate model to education option. According to literature research we sum up four aspects such as teacher, administration, environment and curriculum. The study participants are parents of two schools. We utilize fuzzy data of their membership to four aspects to analysis proper educational quality.

The questionnaire of this study is different from the traditional questionnaire. It is developed by fuzzy theory. Traditional questionnaire ignore fuzzy thinking of human beings unavoidably, and may explain excessively. Thus, we can use fuzzy questionnaire to obtain more accurate information which can reflect experimenters' real opinion. We drew conclusions from the result of study.

1. Expert's fuzzy relative weight, obtain from the membership of four aspects of educational quality, are from 0.226 to 0.273, it shows difference slightly.
2. The fuzzy value of school's quality of School A is different from School B. B school parents' satisfaction compared with the overall quality of education A school parents' satisfaction.

$$Index_{\text{quality of A}} (3.3761) < Index_{\text{quality of B}} (3.9868) .$$

3. School A B parents estimate the quality of education at all levels of satisfaction: If some parents select School A, they should give priority to the Curriculum; if some parents select School B, they should give priority to the Administration
4. The comparative result of Strategy is different from two schools of each aspect, as shown in Table 5.1. In Strategy, we get the conclusion that School A is only superior to School B in Environment.

TABLE 5.1. Emphasize a certain aspects of relation from two schools.

Strategy	school	value of fuzzy decisions	relation
Strategy 1	A	15.76	A<B
Emphasis on Teacher	B	16.18	
Strategy 2	A	11.61	A<B
Emphasis on Administration	B	16.82	
Strategy 3	A	14.13	A>B
Emphasis on Environment	B	14.01	
Strategy 4	A	15.63	A<B
Emphasis on Curriculum	B	16.11	

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