Selecting Partial-Duty Accountants of Elementary Schools by Fuzzy Multiple Criterion Methods

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Abstract

When the principals makes evaluations of teachers to be part-time accounting personnel, they should take into consideration of various standards. This study applied fuzzy multi-criteria decision method to evaluate and select elementary school teachers as part-time accounting personnel, and to offer a more appropriate reference standard for elementary school principals.

People who are teachers and part-time accounting personnel believed that they are evaluated and selected for the jobs, in consideration of aspects, which morality and character is more important than that of personal characteristics and job performances. Strong self-restrain, to listen in concentration with a friendly attitude and not owing credit card debts are the most stressing principal category.

The school scales are related to the principal categories when the principals make evaluations and selections for teachers. According to the difference in school scales, they will have different considerations.

Keywords *: Fuzzy Multi-Criteria Decision Making (FMCDM)、Fuzzy Delphi Method(FDM)、Fuzzy Analytic Hierarchy Process (FAHP)、Teachers with Partial-Duty as Accountants at Elementary School*

1. Introduction

According to regulations in this country, the budgeting and financial operation in schools of different levels and public social education institutions should follow how the governmental organizations operate, which is the governmental budgeting system. The financial and accounting systems in public junior high and elementary schools are restricted by the accounting systems in subsidiary bodies of the government. In addition, the financial accounting relies on the accounting system of ordinary governmental bodies, whose legal reference is Accounting Law and Government Procurement Law. The distinguishing characteristic is the design of the distinctive status of the Accounting & Statistics Department. At present, the purpose of trimming personnel cost in many county (city) governments results in the fact that specialized accountants are not placed to handle accounting businesses in the elementary schools in most counties (cities), leaving them to school teachers and secretaries. Teachers with partial duty as accountants, assigned by school principals under the supervision of audit authority, bear responsibility for the review and control of their schools.

Due to the organizational structure, basic-level accountants in elementary schools, despite understaffed, have to take care of budgeting, accounting and statistical businesses. Under the circumstances, they may encounter difficulty dividing up tasks professionally as required by audit authority. Also, the have to cope with the comprehensive coverage of budgeting, accounting, statistical matters and organizational businesses with regard to regulations and be responsible for legality reviews. Therefore, when a school principal evaluates a teacher filling the position of accountants, his/her accounting experience and moral character and integrity are of great concern.

Staff's quality and the level of specialization will influence the efficiency of school administration. To exploit a person of outstanding ability, the top consideration is to "allow him/her to use skills to the maximum" so that everyone can fulfill his/her ambition and make good use of his/her strength. (Cheng, 2002)[3] Therefore, when a school principal selects a teacher with partial duty as accountant,

his/her personality, interpersonal skills and background are all to be taken into account.

In view of this, multiple criteria must be considered when teachers filling the post of accountants are selected. Which is of great importance and what its influencing weights are will affect the finalization. This study, as a result, uses Fuzzy Multi-Criteria Decision Making (FMCDM) together with the view from teachers working as part-time accountants to analyze and provide crucial factors as appropriate guidelines for elementary school principals.

The objects of this study are teachers filling the role of school accountants, whose understanding of accounting businesses in elementary schools is where the study focuses. Moreover, by adopting Fuzzy Delphi Method (FDM), expert questionnaires are distributed to elementary school teachers help share accountants' duty so as to establish guidelines for elementary school principals' finalization. Then, Fuzzy Analytic Hierarchy Process (FAHP) will be employed to calculate the weights of each guideline and to understand the process of selecting teachers who fill the post of accountants conducted by principals of elementary schools. This is to systematically establish a procedure for finalizing the teachers capable of handling accountants' businesses chosen by school principals and to understand to what extent adjustment should be made to resources, capability, service quality and perceived value of the teachers filling the position of accountants in order to accomplish this task.

2. FDM and FAHP

2.1 FDM (Fuzzy Delphi Method)

Initially, Delphi Method was developed by Dalkey of Rand Corp and his assistant to predict possible military events. Inviting experts in a specific area via letters from the organization making forecasts is how it works. Experts will be asked individually to give their forecast opinions on a described matter and none of them knows any other participants. Opinions are not exchanged in advance as well. Subsequently, a coordinator from the organization making forecasts will synthesize experts' ideas, figure the distribution and calculate the median and what opinions are in the middle 50%. After that, the experts will be mailed to refer to the information for another forecast and reasons may have to be offered if his/her opinion is outside the opinions in the middle 50%. Upon receipt of second-round responses, the organization will synthesize them again, repeat what was done first time and supply the experts with new data as a basis for modifying the forecast next time. It can be repeated for three to four times.

However, owing to certain defects in the traditional Delphi Method, scholars of this field released their results of FDM one after another in an attempt to make improvements to it.

Ishikawa and others introduced Fuzzy Theory into Delphi Method in 1993 and established the two methods, Max-Min and Fuzzy Integration, for the first time(Ishikawa,1993)[5]. Moreover, they showed the applicability of both methods by demonstrating experts' forecasts about "the likely time of computer's popularization."

In the Max-Min Method, at first put the data obtained from experts' questionnaires together and establish separately the cumulative frequency function $F_1(x)$ for "the most likely achieving time" and $F_2(x)$ for "the most unlikely achieving time." Then, calculate separately the quartiles （c_1, d_1） and the median m_1 for $F_1(x)$, and the quartiles （c_2, d_2） and the median m_2 for $F_2(x)$. After that, combine （c_1, d_1, m_1） and （c_2, d_2, m_2） to obtain the membership functions of both the "the most likely attainable time" and "the most unlikely attainable time." The point where the two membership functions intersect in the gray area is the forecast value X. Details are shown in Figure 1.

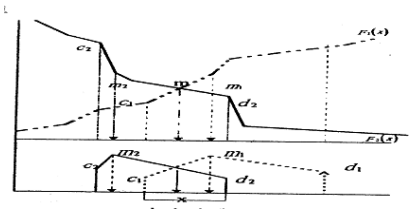

Figure 1 Figure of Max-Min forecast value (Ishikawa et al., 1993)[5]

In the Fuzzy Integration, data collected from the questionnaire items helps us separately establish the "attainable" and "unattainable" membership functions, h_t and h_u, as well as define the composite function of the both as $h_i(x)$=min(h_t, h_u). Next, the accessible value of each year can be acquired following Fuzzy Integration calculation, with the maximum value being the required forecast value. It is shown in Figure 2

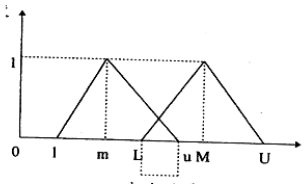

Figure 2 Membership functions of questionnaire items (Ishikawa et al., 1993)[5]

In study carried out by Lee and Chang (1999)[1], the following are the procedures taken in the study which was grounded on the FDM proposed by Ishikawa et al. (1993)[5].

1. Determining the evaluation: Determining the evaluating set elements through the questionnaires done by credit assessment staff. Apart from the "Absolutely good", which gets 100 points, and "Absolutely bad", which gets zero point, of the traditional Two-Value Logic, other evaluating set elements are to be coped with by objectively quantifying them via FDM.

2. Quantifying the evaluating set elements: Design a questionnaire for the evaluating set elements except "Absolutely good" and "Absolutely bad". Let experts write down the quantified point interval value for the particular evaluating set element. The maximum value of the interval value is the most optimistic cognition of the quantified point of that particular evaluating set element, and the minimum value of the interval value is the most conservative cognition of the quantified point of that particular evaluating set element.

3. Finding extreme value: Separately find out the minimum value L_i , geometric mean M_i and maximum value U_i of every expert's the most optimistic cognition point of each evaluating set element, and the minimum value li, geometric mean m_i and maximum value u_i of the most conservative cognition point.

4. Establishing triangular fuzzy numbers: Separately establish the triangular fuzzy number $A_i = (L_i, M_i, U_i)_{\text{L-R}}$ of every expert's most optimistic cognition of each evaluating set element, and the triangular fuzzy number $a_i = (l_i, m_i, u_i)_{L-R}$ of the most conservative cognition, as shown in Figure 3.

5. Examining convergence: This research examines experts' cognition to see if the result of convergence is reached through "gray area test.

To examine whether the gray area exists or not If $u_i < L_i$, it means that experts do not reach convergence for the comparison of the most optimistic cognition and the most conservative cognition, resulting in no gray area. In other words, experts' cognition for the comparison of the interval does not reach a stable effect.

If the gray area $G_i = u_i - L_i$ of the comparison is greater than the geometric mean $C_i = M_i - m_i$ of experts' cognition for the comparison of the interval value, it represents that the gray area does not reach convergence, meaning that the fuzzy interval of the gray area is greater than the interval value obtained in the traditional Delphi Method.

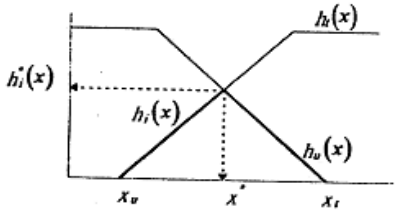

Figure 3 The triangular fuzzy number of the most optimistic and the most conservative cognition

If research result displays the two aforementioned situations, have the geometric mean (m_i, M_i) of the interval value from each comparison for experts' references and then make the next questionnaire. Repeat step 1 to 5 until all evaluating set elements reach convergence. The triangular fuzzy number of "the most optimistic" and "the most conservative" cognition is used to integrate experts' views, which is " the maximum and minimum value in the possibility range" rather than "the most likely" and "the most unlikely" ones in the traditional Two-Value Logic. Experts' range of cognition can therefore be reduced, making only one round of questionnaire preparation is required in most situations.

6.Quantified point: If $u_i > L_i$ and $G_i < C_i$, then calculate the crossing point of the two triangular fuzzy numbers, which is the quantified point of that evaluating set element. The crossing point can be obtained from the equation below:

$$CP\left(u_{\tilde{L}}, u_{\tilde{S}}\right) = max\left\{\int_x \left(min\left\{u_{\tilde{L}}(x_i), u_{\tilde{S}}(x_i)\right\}\right)dx\right\}$$

This FDM model has the following advantages: (Lee and Chang, 1999)[1]

1 Using triangular fuzzy number to integrate experts' cognition can remedy the flaw that merely information in the middle 50% is offered in the

traditional Delphi Method. In addition, it can specify the fuzziness and uncertainty in human thoughts.

2. Using the gray area test to test whether experts' cognition reaches convergence or not encourages a more exact and reasonable analysis of FDM.

3. Using the concept of "the maximum and minimum value of the possibility range" to replace the concept of "the most likely" and "the most unlikely" adopted by Ishikawa et al.(1993)[5] can enhance practicality of FDM model.

4. The FDM model established in the study requires only one round of questionnaire preparation, avoiding the wasting of time, endeavors and costs.

2.2 FAHP (Fuzzy Analytic Hierarchy Process)

AHP, introduced by Saaty in 1980, has since been used to analyze and review complicated decision-making problems layer by layer and solve multi-layered decision-making problems smoothly by pair-wise comparison matrix. It is therefore being widely employed to look into multi-layered decision-making problems under the circumstances of uncertainty; however, owing to its defects while being used (Buckley, 1985[4]; Cheng, 1994[2]) and its inability to match people's objectivity, fuzziness and inaccuracy towards multi-layered decision-making problems, plenty of scholars have been making improvement to it through statistical methods and Fuzzy Theory in recent years.

FAHP is the expansion of the AHP taking fuzzy environment into consideration (Ruining and Xiaoyan, 1992[7]) so as to effectively remedy the deficiency in the application of AHP.

This study refers to the ideas and practice from scholars of such field to make improvement to FAHP, hoping that FAHP allows competent teachers to consider the weight of evaluating aspects and items reviewed by elementary school principals to choose teachers who fill the role of accountants. The steps of its application are as below:

1. Establishing hierarchical structure: At first, establish hierarchical structure via factor analysis. The first layer represents the ultimate goal (the most suitable evaluating program model, the second layer means the main criteria influencing the ultimate goal (aspects), and the third layer represents the important evaluating items influencing the main criteria (the evaluating items covered by every aspect).

2. Establishing pair-wise comparison matrix: From the result of the questionnaires, views on evaluating the relative importance of the two important evaluating items i and j of the third layer from the experts K under a certain main criterion of the second layer can be obtained. Then, the pair-wise comparison matrix can be established.

3. Establishing triangular fuzzy number: Objectivity, fuzziness and inaccuracy tend to characterize human thoughts. As a result, using fuzzy number to integrate and evaluate experts' cognition is suitable for every value in the pair-wise comparison matrix. Robbins (1994)[6] supposed that using triangular fuzzy number to integrate and evaluate experts' opinions can properly represent the fuzziness of evaluating experts' views on the relative importance of the pair-wise factors. The procedures can acquire the triangular fuzzy number through the equation below.

$$\tilde{\alpha}\, ij = (\alpha ij, \beta ij, \delta ij)L - R \qquad (1)$$

4. Establishing fuzzy positive reciprocal matrix: Establish triangular fuzzy number, and then use it to represent the fuzziness for evaluating experts' opinions. The fuzzy positive reciprocal matrix A can subsequently be established.

$$A = \left[\tilde{\alpha}\, ij\right] \qquad (2)$$

$$\tilde{\alpha}\, ij = (\alpha ij, \beta ij, \delta ij)$$

5. Calculating fuzzy weights in the fuzzy positive reciprocal matrix: The method lets experts put in crisp value. Then it combines experts' opinions through geometric mean to replace the experts' direct input of the fuzzy number. By doing this, consistency is covered and the concept of Normalization is achieved. Fuzzy weights can be seen from the following equation:

$$Z_i = \left[\tilde{\alpha}_{i1} \otimes ..... \otimes \tilde{\alpha}_{in}\right]^{1/n}, \forall_i$$
$$\overline{W_i} = Z_i \otimes (Z_1 \oplus ..... \oplus Z_n)^{-1} \qquad (3)$$

6. Calculate α-cuts value: The process of comparing the priority of each alternative directly from the triangular fuzzy number is more complicated. Also, the study aims to let decision-maker know the change of alternative outranking under various α -levels. Therefore, α-cuts is employed to conduct defuzzification. In other words, the fuzzy weight $\overline{W_i}$ of each alternative is aimed according to equation (4)

and (5) to obtain the left-side value $\overline{W_i}$ and right-side value $\overline{W_i}$ under different α-levels.

$$\overline{W_i} = (W_{iL}, W_{iM}, W_{iU})$$

$$W_{il}^{\alpha} = (W_{iM} - W_{iL})\alpha + W_{iL} \quad (4)$$

$$W_{iU}^{\alpha} = (W_{iU} - W_{iM})\alpha + W_{iU} \quad (5)$$

7. Fzzification: Due to the fact that there is no way to make comparisons from interval value, this study conducts defuzzification by means of Convex Combination and make comparison with priority of each alternative by using crisp value by means of linear combination. This model acquires the weights of each alternative under different pessimism degree (λ) and α level according to equation (6).

$$W_i^{\alpha} = \lambda W_{il}^{\alpha} + (1-\lambda) W_{iu}^{\alpha} \quad (6)$$

α: α-cuts，0≤α≤1。

λ: Index of Pessimism- representing decision makers' pessimism degree. 0≤λ≤1

When λ=1 (entire pessimism), the result will be $W_i^{\alpha} = W_{il}^{\alpha}$, equaling the employment of min principle.

When λ=0 (entire optimism), the result will be $W_i^{\alpha} = W_{iu}^{\alpha}$, equaling the employment of max principle.

8. Normalization: In order to compare the relative priority of each alternative under the same α-levels, the result in step 7 will be normalized according to the equation (7).

$$W_i^{\alpha} = W_i^{\alpha} / \sum W_i^{\alpha} \quad (7)$$

9. Sensitivity Analysis: There are two parameters, α and λ in equation (6) as well as 0≤α≤1 and 0≤λ≤1. Therefore, when different α and λ values are given, different alternative weighting value will be obtained. Different α values can use simulating decision-making environment to change the status λ value can be seen as a means to synthesize experts' ideas. For this reason, this study sets out to conduct Sensitivity Analysis under different pessimism degree λ in order to understand the change of the relative priority degree of each alternative under different α-levels.

If alternatives are not evaluated directly and the weights of each evaluating item are calculated instead, the procedures after step 5 are changed as follows:

1. Defuzzification: Due to the fact that the weights of each main criterion and evaluating item are fuzzy value, it is a must to obtain the Nofuzzy Value through defuzzification in order to acquire the weights of how teachers filling the position of accountants think about the evaluating aspects and items of elementary school principals' choosing teachers who are competent to be accountants. H. J. Zimmermann (1991)[8] believed that defuzzification is considered reasonable in principle and is empirically feasible. It is a method of effectiveness in calculating, too. In the study, reasons for using the gravity method to defuzzify are as follows. Firstly, gravity method is widely employed in various kinds of references. Secondly, the way of getting an answer is quite fast. When the weights are triangular fuzzy, the calculating process of non-fuzzy value of the weights can be simplified as below:

$$W_i = \frac{W_{\alpha i} + W_{\beta i} + W_{\delta i}}{3}$$

2. Normalization: In order to compare the importance between different main criteria and evaluating items easily, the obtained weight value needs to be normalized. The process of normalizing the weight value is shown as follows:

$$NW_i = W_i \Big/ \sum_{i=1}^{i=n} W_i$$

3. Series of Hierarchy: The weights of the ith main criteria at the second layer under the ultimate goal at the first layer and the weights of the pth evaluating item at the third layer under the ith main criteria at the second layer can be acquired when the aforementioned steps are referred to. If the weights of the pth evaluating item at the third layer under the ultimate goal at the first layer are to be obtained, series of hierarchy must be conducted (Lee and Chang, 1999)[1] The method of it works is shown below:

$$NW_k = NW_i \times NW_{ip}$$

3. Aspects and items of teachers

In order to understand the views of teachers responsible for accounting posts on evaluating criteria, this study, in particular, picks teachers serving partial duty as accountants as the objects of the study. Self-evaluated questionnaires are distributed to understand teachers' views on important items and weights of how to be selected as those sharing accountants' duty.

The evaluating criteria that they care about are summarized as follows after interviews with experts:

1. whether a teacher is cautious or not
2. whether a teacher shows great self-control or not
3. whether a teacher has a sharp sense in figures or not
4. whether a teacher is patient or not
5. whether a teacher is willing to learn new things or not
6. whether a teacher is persevering or not
7. whether a teacher is willing to work partially as an accountant for a long time or not
8. whether a teacher sticks to his/her principles thoroughly or not
9. whether a teacher's honesty is credible or not
10. whether a teacher's performance at work is reliable or not
11. whether a teacher is conscientious and handles tasks without delay or not
12. whether a teacher is capable of working hard and enduring hardship or not
13. whether a teacher can deliver message accurately or not
14. whether a teacher listens attentively with a friendly manner or not
15. whether a teacher thinks from the standpoint of other people or not
16. whether a teacher is diplomatic about getting along with other people or not
17. whether a teacher is well-versed in accounting law or not
18. whether a teacher is well-versed in government purchase law or not
19. whether a teacher has sufficient information ability or not
20. whether a teacher has a professional accountant background or not
21. whether a teacher's annual assessment is up to standard or not
22. whether a teacher has ever broken the law or not
23. whether a teacher has card debts or takes out a loan without repaying it or not
24. whether a teacher is a subject teacher rather than a class instructor or not
25. whether a teacher remains single and unmarried at the moment or not
26. whether a teacher lives near school or not
27. a teacher's personal inclination
28. a teacher's seniority attained at the school

4. Fuzzy Multi-Criteria Empirical Analysis

4.1 The triangular fuzzy number of teachers filling the post of accountants who are the objects of this study

Table 1 The triangular fuzzy number of teachers filling the post of accountants who are the objects of this study at schools having 6 classes

Items	Min	Consensus mean	Max
Personal traits			
2 You show great self-control	3	4.90	7
Performance at work			
8 Your honesty is credible	5	5.81	7
9 Your performance at work is reliable	4	5.25	7
10You are conscientious and handle tasks without delay	5	5.95	7
11 You are capable of working hard and enduring hardship	5	5.60	7
12 You are willing to learn new things	5	5.60	7
13 You can deliver message accurately	4	4.90	7
14 You listen attentively with a friendly manner	6	5.60	7
Moral character and integrity			
21 Your annual assessment is up to standard each year	6	6.30	7
22 You have no record of breaking the law	7	6.65	7
23 You have no card debts or did not take out a loan without repaying it	6	6.09	7

Table 2 The triangular fuzzy number of teachers filling the post of accountants who are the objects of this study at schools having 7 to 24 classes

Items	Min	Consensus mean	Max
Performance at work			
8 Your honesty is credible	5	5.95	7
9 Your performance at work is reliable	5	5.25	7
10 You are conscientious and handle tasks without delay	6	5.95	7
11 You are capable of working hard and enduring hardship	5	5.25	7
14 You listen attentively with a friendly manner	4	5.39	7

15 You think from the standpoint of other people	4	5.39	7
moral character and integrity			
21 Your annual assessment is up to standard each year	4	5.35	7
22 You have no record of breaking the law	4	5.35	7
23 You have no card debts or did not take out a loan without repaying it	4	5.35	7

Table 3 The triangular fuzzy number of teachers filling the post of accountants who are the objects of this study at schools having over 25 classes

Items	Min	Consensus mean	Max
Personal traits			
1 You are cautious	5	4.90	7
2 You show great self-control	5	5.60	7
Performance at work			
8 Your honesty is credible	5	5.60	7
9 Your performance at work is reliable	6	6.30	7
10 You are conscientious and handle tasks without delay	5	5.60	7
11 You are capable of working hard and enduring hardship	6	6.30	7
12 You are willing to learn new things	6	6.30	7
13 You can deliver message accurately	4	5.25	7
14 You listen attentively with a friendly manner	6	6.30	7
15 You think from the standpoint of other people	5	5.60	7
Moral character and integrity			
21 Your annual assessment is up to standard each year	6	6.30	7
22 You have no record of breaking the law	6	6.30	7
23 You have no card debts or did not take out a loan without repaying it	6	6.30	7

It can be inferred from Table 1, 2 and 3 that when reviewing being selected as teachers filling the role of accountants, the teachers think they care about self-control better in terms of personal traits. With respect to performance at work, they care about being conscientious and complete tasks without delay. As to moral character and integrity, they care about if they have any record of breaking the law.

4.2 The triangular fuzzy weights of teachers filling the role of accountants who are the objects of this study

According to the result of questionnaires, evaluating people K's view on the relative importance of the pair-wise main criteria at the second layer under a certain main criterion at the first layer can be obtainedAlso, the view on the relative importance of the pair-wise evaluating items at the third layer under each main criterion can be obtained so as to establish the pair-wise comparison matrix. This study integrates all evaluating people's opinions and represents the fuzziness of their views on the relative importance of the pair-wise factors through triangular fuzzy number.

$$\tilde{\alpha} ij = (\alpha ij, \beta ij, \delta ij) L - R$$

The triangular fuzzy number is to be established and is then used to represent the fuzziness of evaluating people's opinions, leading the way to further establish the fuzzy positive reciprocal matrix A.

$$A = \left[\tilde{\alpha} ij \right]$$

$$\tilde{\alpha} ij = (\alpha ij, \beta ij, \delta ij)$$

After establishing the fuzzy positive reciprocal matrix, this study uses Buckley's method (1985)[4] of calculating the fuzzy weights. This method not only involves consistency but also achieves the concept of Normalization.

$$Z_i = \left[\tilde{\alpha}_{i1} \otimes ..... \otimes \tilde{\alpha}_{in} \right]^{1/n}, \forall_i$$

$$\overline{W_i} = Z_i \otimes (Z_1 \oplus ..... \oplus Z_n)^{-1}$$

Table 4 The fuzzy weights of evaluating items of teachers filling the post of accountants who are the objects of this study at schools having 6 classes

Items	Min	Mean	Max

Personal traits	0.327	0.633	1.225
2 You show great self-control	0.310	0.758	1.852
Performance at work	0.408	0.714	1.247
8 Your honesty is credible	0.240	0.552	1.267
9 Your performance at work is reliable	0.232	0.617	1.637
10 You are conscientious and handle tasks without delay	0.295	0.917	2.854
11 You are capable of working hard and enduring hardship	0.401	0.957	2.284
12 You are willing to learn new things	0.585	1.320	2.981
13 You can deliver message accurately	0.534	1.253	2.940
14 You listen attentively with a friendly manner	0.538	1.408	3.684
Moral character and integrity	1.225	2.213	4.000
21 Your annual assessment is up to standard each year	0.111	0.333	1.000
22 You have no record of breaking the law	0.333	1.000	3.000
23 You have no card debts or did not take out a loan without repaying it	1.000	3.000	9.000

Table 5 The fuzzy weights of evaluating items of teachers filling the post of accountants who are the objects of this study at schools having 7 to 24 classes

Items	Min	Mean	Max
Performance at work	0.333	0.904	2.449
8 Your honesty is credible	0.157	0.408	1.060
9 Your performance at work is reliable	0.271	0.627	1.450
10 You are conscientious and handle tasks without delay	0.312	0.743	1.768
11 You are capable of working hard and enduring hardship	0.359	0.932	2.420
14 You listen attentively with a friendly manner	0.730	1.594	3.477
15 You think from the standpoint of other people	0.749	1.834	4.491
Moral character and integrity	0.667	2.449	9.000
21 Your annual assessment is up to standard each year	0.111	0.333	1.000
22 You have no record of breaking the law	0.333	1.000	3.000
23 You have no card debts or did not take out a loan without repaying it	1.000	3.000	9.000

Table 6 The fuzzy weights of evaluating items of teachers filling the post of accountants who are the objects of this study at schools having over 25 classes

Items	Min	Mean	Max
Personal traits	0.167	0.333	0.667
1 You are cautious	0.250	0.389	0.606
2 You show great self-control	0.485	0.678	0.947
Performance at work	0.408	0.816	1.633
8 Your honesty is credible	0.177	0.332	0.626
9 Your performance at work is reliable	0.256	0.441	0.759
10 You are conscientious and handle tasks without delay	0.371	0.810	1.768
11 You are capable of working hard and enduring hardship	0.453	0.805	1.429
12 You are willing to learn new things	0.657	1.475	3.312
13 You can deliver message accurately	0.800	1.556	3.022
14 You listen attentively with a friendly manner	1.050	1.967	3.684
15 You think from the standpoint of other people	1.343	2.318	4.000
Moral character and integrity	1.500	3.674	9.000
21 Your annual assessment is up to standard each year	0.111	0.191	0.327
22 You have no record of breaking the law	0.667	1.144	1.964
23 You have no card debts or did not take out a loan without repaying it	2.333	4.583	9.000

4.3 Result analysis following defuzzification

The weights of each main criterion and sub-evaluating items attained from Table 4 to 6 are all fuzzy values. The Nofuzzy Value must be acquired in order to obtain the weights used to evaluate items of financial institutions. As a result, defuzzification must be conducted and the theory of gravity method is to obtain the gravity of a triangle.

$$W_i = \frac{W_{\alpha i} + W_{\beta i} + W_{\delta i}}{3}$$

In order to conveniently compare the significance of different main criteria and sub-criteria, which are the evaluating items, the obtained weight value should be normalized. ◦

Table 7 The weights of defuzzified criteria of the evaluating items of teachers filling accountants' post who are the objects of this study at schools having 6 classes

Items	Weights of defuzzified criteria
Personal traits	0.182
2 You show great self-control	0.182
Performance at work	0.198
8 Your honesty is credible	0.012
9 Your performance at work is reliable	0.015
10 You are conscientious and handle tasks without delay	0.029
11 You are capable of working hard and enduring hardship	0.026
12 You are willing to learn new things	0.035
13 You can deliver message accurately	0.034
14 You listen attentively with a friendly manner	0.040
Moral character and integrity	0.620
21 Your annual assessment is up to standard each year	0.048
22 You have no record of breaking the law	0.143
23 You have no card debts or did not take out a loan without repaying it	0.429

Table 8 The weights of defuzzified criteria of the evaluating items of teachers filling accountants' post who are the objects of this study at schools having 7 to 24 classes

Items	Weights of defuzzified criteria
Performance at work	0.233
8 Your honesty is credible	0.016
9 Your performance at work is reliable	0.023
10 You are conscientious and handle tasks without delay	0.028
11 You are capable of working hard and enduring hardship	0.037
14 You listen attentively with a friendly manner	0.058
15 You think from the standpoint of other people	0.071
Moral character and integrity	0.767
21 Your annual assessment is up to standard each year	0.059
22 You have no record of breaking the law	0.177
23 You have no card debts or did not take out a loan without repaying it	0.531

Table 9 The weights of defuzzified criteria of the evaluating items of teachers filling accountants' post who are the objects of this study at schools having over 25 classes

Items	Weights of defuzzified criteria
Personal traits	0.064
1 You are cautious	0.024
2 You show great self-control	0.040
Performance at work	0.157
8 Your honesty is credible	0.005
9 Your performance at work is reliable	0.007
10 You are conscientious and handle tasks without delay	0.014
11 You are capable of working hard and enduring hardship	0.013
12 You are willing to learn new things	0.026
13 You can deliver message accurately	0.025
14 You listen attentively with a friendly manner	0.031
15 You think from the standpoint of other people	0.036
Moral character and integrity	0.779
21 Your annual assessment is up to standard each year	0.024
22 You have no record of breaking the law	0.145
23 You have no card debts or did not take out a loan without repaying it	0.610

Put the data obtaining from Table 7 to 9 together and gets the ranking of the defuzzified criteria of the evaluating items, which is shown in Table 10 to 12.

Table 10 The top-six ranking of the defuzzified criteria of the evaluating items at schools having 6 classes

Reearch target / Items / Ranking	Teachers filling the post of accountants
Personal traits	
1 cautious	-
2 show great self-control	②
3 have a sharp sense in figures	-
4 patient	-
5 persevering	-
16 diplomatic about getting along with other people	-
Performance at work	
8 honesty is credible	
9 performance at work is reliable	
10 conscientious and handle tasks without delay	
11 capable of working hard and enduring hardship	
12 willing to learn new things	⑥
13 deliver message accurately	
14 listen attentively with a friendly manner	⑤
15 think from the standpoint of other people	
Moral character and integrity	
21 annual assessment is up to standard each year	④
22 have no record of breaking the law	③
23 have no card debts and did not take out a loan without repaying it	①

Table 11 The top-six ranking of the defuzzified criteria of the evaluating items at schools having 7 to 24 classes

Reearch target / Items / Ranking	Teachers filling the post of accountants
Personal traits	
1 cautious	-
2 show great self-control	-
3 have a sharp sense in figures	-
4 patient	-
5 persevering	-
16 diplomatic about getting along with other people	-
Performance at work	
8 honesty is credible	
9 performance at work is reliable	
10 conscientious and handle tasks without delay	
11 capable of working hard and enduring hardship	⑥
12 willing to learn new things	-
13 deliver message accurately	-
14 listen attentively with a friendly manner	⑤
15 think from the standpoint of other people	③
Moral character and integrity	
21 annual assessment is up to standard each year	④
22 have no record of breaking the law	②
23 have no card debts and did not take out a loan without repaying it	①

Table 12 The top-six ranking of the defuzzified criteria of the evaluating items at schools having over 25 classes

Reearch target / Items / Ranking	Teachers filling the post of accountants
Personal traits	
1 cautious	-
2 show great self-control	-
3 have a sharp sense in figures	-
4 patient	-
5 persevering	-
16 diplomatic about getting along with other people	-
Performance at work	
8 honesty is credible	
9 performance at work is reliable	
10 conscientious and handle tasks without delay	
11 capable of working hard and enduring hardship	⑥
12 willing to learn new things	-
13 deliver message accurately	-
14 listen attentively with a friendly manner	⑤
15 think from the standpoint of other people	③
Moral character and integrity	
21 annual assessment is up to standard each year	④
22 have no record of breaking the law	②
23 have no card debts and did not take out a loan without repaying it	①

It can be judged from Table 10 to 12 that among all the criteria, "*have no card debts and did not take out a loan without repaying it*" and "*have no record of breaking the law*" are the significant factors that teachers filling the post of accountants are concerned, between which "*have no card debts and did not take out a loan without repaying it*" is what the teachers

consider the most important one, showing that they obviously care about "*moral character and integrity*" more than any other aspects. In addition, as to "*personal traits*", aside from "*show great self-control*", they show low level of concerns and consensus about the rest, signifying that teachers filling the post of accountants are concerned more about their own performance. In terms of "*performance at work*", they care about "*capable of working hard and enduring hardship*", "*be willing to learn new things*", "*listen attentively with a friendly manner*" and "*think from the standpoint of other people*." On the whole, teachers filling the position of accountants tend to care about the ability to handle tasks, hoping to tackle tasks perfectly.

5. Conclusion and Suggestions

Factors influencing the elementary-school principals' evaluation of teachers filling the post of accountants are numerous and intricate and the decision-making environment they face is crammed full of uncertainty and subjectivity. This study, as a consequence, attempts to seek the most suitable method and process to solve this problem through fuzzy decision-making theory and to investigate into the evaluating items and weights that teachers filling the post of accountants themselves consider about being chosen as the ones. The result of which may be presented for teachers' reference. According to the result of this study, its conclusion, suggestion and contribution are as follows.

5.1 Conclusion

For teachers filling the post of accountants themselves considering about being chosen as such ones, in terms of all aspects, the one of moral character and integrity prevails over the one of personal traits and the one of performance at work. As to personal traits, showing great self-control is more important than any other items. Regarding performance at work, listening attentively with a friendly manner is more vital than any other items. Finally, when moral character and integrity is concerned, having no card debts and not taking out a loan without repaying it is considered the key item.

In the past, there was no similar study by any scholar. This results in the difficulty in collecting and deriving criteria from past research. Through personal experience and interviews with experts, this study, eventually, acquires relatively objective criteria and items by deriving experts' opinions from the use of FDM.

The evaluating method, procedures and results of how elementary-school principals select teachers filling the post of accountants deriving from this study can assist principals in settling the guiding principles under the knotty and uncertain environment. Decision can therefore be made to boost school efficiency.

5.2 Suggestions

Owing to the restraint on time, information accessibility and personal ability of this study, the investigation into this issue is rudimentary. Also, data concerning teachers filling the post of accountants at the elementary schools in Yunlin County are collected in this study. The following researchers can expand the sample area to the entire Taiwan so as to further extend the range of data analysis in this study.

The accessibility of quantified standards and data of each criterion is not easy. It is suggested that the following researchers make improvement to the problem of quantifying to make their study more complete.

5.3 Contribution

Due to the absence of relevant past studies, this study serves as the first to analyze and examine this issue, whose result may be offered for the references of academia and practice field.

It can be obtained from the conclusion of this study the ranking of crucial criteria for teachers filling the post of accountants to self-evaluate reasons for being chosen as accountants. It can be deemed as the guiding principles for self-learning and self-developing for teachers who intend to become teachers filling the post of accountants.

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