

# Construct the Educational Training Model of the Taiwanese Bakery Industry by using Consistent Fuzzy Preference Relation Analytic Hierarchy Process

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**Abstract:** Whereas Taiwan baking industry is actively participating in large baking competitions, therefore, the more baking talents are in need. However, the good education and training have become urgent issues on the baking industry because of the shortage of qualified technical manpower. The research aim is to build an educational training model for the Taiwan baking industry. We use the research method which is called Consistent Fuzzy Preference Relationship Hierarchy Analysis (CFPR-AHP). CFPR-AHP is a better method than traditional AHP because it could solve the inconsistency of AHP and reduce the questionnaire burden of the respondents. The results are from seven practical experts with an average of 35.2 years of working experiences who have verified the simulation cases and have evaluated the applicability of the model. Also, five levels and 20 evaluation items have been established. The results show that the baking industry training model is composed of creativity, cultural awareness and teaching staff, as well as originality, ethics of mentorship and multiple experiences. The research uses CFPR-AHP such an innovative method to construct the educational training model for Taiwan Baking Industry. It will be helpful for launching the educational training model and also to provide the new training model for the government.

**Key-Words:** Consistent fuzzy preference relation analytic hierarchy process, Taiwanese bakery industry, Originality, Master-apprentice ethics, Creative thinking skill.

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## 1 Introduction

American Bakers Association (ABA) published 2018 convention bulletin which announced that the baking industry is recognized as essential to healthy families and a healthy economy. Baking companies in Taiwan have actively participated in large-scale exhibitions in recent years. Many of the creative baking products of the Taiwan's students have appeared in the international baking competition. Bakery industry is not only a food industry, but also spans the scope of service and tourism industry, forming a variety of baking characteristics in Taiwan. The bakery industry in Taiwan has exceeded 5,500 bakery stores and 12,000 convenience stores and coffee shops. Due to the growth of bakery products, Jing [11] found that many senior high school students are interested in studying in university's hospitality-related departments, especially majoring in bakery field. However, According to statistics from the Executive Yuan's Directorate-General of Budget, Accounting and Statistics in Taiwan, there were roughly 218,000

manpower vacancies in the industrial and service sectors in 2017. Manpower shortage is an urgent issue for the service industry in Taiwan. Therefore, through current training of Taiwan's technical and vocational education, schools should build the source of future talent in the bakery industry. In order to avoid the gap between industry and academic, that is, training professional talents required by the bakery industry, we are necessary to construct the educational training model of the baking industry in Taiwan. Therefore, this paper focuses on the industrial perspective. The purpose of this paper is to establish the educational and training model of the Taiwanese bakery industry with the application of the consistent fuzzy preference relation analytic hierarchy process. Herrera-Viedma, Herrera, and Luque [5] proposed the Consistent Fuzzy Preference Relation (CFPR) method, which skips the consistency verification during the decision-making process. Moreover, it just needs n-1 pair-wise comparisons in an n×n evaluation matrix. Thirdly, the pair-wise comparison between the attributes for

CFPR is more transitive. This paper is organized as follows. In section II, we describe literature review. Section III presents the methodology. In section IV, we describe the results. Conclusions show in the section V.

## 2 Literature Review

Educational institutions are regarded as service institutions which provide educational services for students Gruber, Fub, and Glaser-Zikuda [6]. Good learning environments of the educational institution can induce students to learn knowledge and skills initiatively. That is to say, the teaching staff's experience and teaching ability are absolutely influential Chen [3]. Of course, good curriculum design, good academic reputation, comfortable campus environment and participation in extracurricular activities mean that the school has the ability to advance the students' quality and further industry talent Wang [16] and Hu [9]. Devine, Baum, and Hearn [5] provide some suggestions about multicultural issues that challenge hospitality and tourism academics. First, hospitality schools and departments should think about offering cultural diversity within their programs. Moreover, hospitality academics believe that students, academics and industry employees may be more culturally aware in dealing with multicultural dilemmas if students and academics have more education and training on cultural diversity and or multiculturalism. They think that a 'Cultural Awareness Development Scheme' would be a proper vehicle for both student and staff integration and communication abilities across cultural diversities. Jeffrey and Craft [10] think that creativity can be leaned through education. Innovative teaching can provide more creative students by Brassler and Dettmers [2] and Letty, Kwan, Leung, and Liou [13]. On one hand, culture is a source of creative inspiration, and culture influences how people understand creativity. On the other hand, creativity and innovation transform culture.

Based on the literature survey, the educational training model of Taiwanese bakery industry is divided into the following five dimensions: (A) curriculum design, (B) teaching staff, (C) learning environment, (D) cultural awareness, (E) creativity. Then, it will be further subdivided into 20 evaluation items. According to the strategy of technical and vocational education in the United Nations Educational, Scientific and Cultural Organization, technical and vocational education must cultivate practitioners' practical skills, and enable students to acquire and improve the

knowledge and skills necessary to perform a certain profession UNESCO-UNEVOC [15]. In order to accomplish this strategy, we collect industry expert questionnaires to analyze the above five dimension weights, because understanding experts' viewpoints can provide valuable information for school management. Therefore, educational institutes can definitively design educational programs. The purpose of this study is to construct the evaluation framework of the key factors in the educational training model of the Taiwanese bakery industry.

## 3 Methodology

### 3.1 CFPR AHP Method

Analytic Hierarchy Process (AHP) is one of multi-criteria decision making method and used for requirements prioritization that was originally proposed by Professor Thomas L. Saaty. However, AHP has the problems of inconsistency and many pair-wise comparisons Bozoki and Rapcsak [1] and Macharis, Springael, De Brucker, and Verbeke [14]. Then Herrera-Viedma et al. [7] proposed the Consistent Fuzzy Preference Relation (CFPR) method that skips the consistency verification during the decision-making process. Moreover, in an  $n \times n$  evaluation matrix,  $n(n-1)/2$  pair-wise comparisons needs to be conducted when using the AHP method, but the Consistent Fuzzy Preference Relation method just needs  $(n-1)$  pair-wise comparisons. Thirdly, the pair-wise comparison between the attributes for the consistent fuzzy preference relation is more transitive. For example, if A is more optimal than B, and B is more optimal than C, then A is definitely more optimal than C.

The traditional AHP method is developed for a long time, and it is supported by some application software. For example, there are some software such as Expert Choice and Super Decisions which are so convenient for the users. Although the CFPR AHP is a good method for improving the traditional AHP, there is no easy-to-use software for the CFPR AHP. This study will construct the easy-to-use Excel procedure for the CFPR AHP to allow researchers to easily use the CFPR AHP method.

### 3.2 CFPR AHP Calculation Steps

This study lists the following items from literature survey as the study framework, which is composed of 20 items and classified into 5 categories. The hierarchy structure of this study includes five groups, (A) Curriculum Design, (B) Teaching Staff, (C) Learning Environment, (D)

Cultural Awareness, and (E) Creativity. These are further subdivided into 20 items. This paper builds the framework of the educational training module for students in the baking industry in Taiwan.

Consistent Fuzzy Preference Relation Analytic Hierarchy Process as follows:

**Step 1:** Design the contents of the expert survey questionnaire: The CFPR AHP method conducts a survey among industry experts to collect their opinions. The questionnaire content includes (1) the definition of the scale, (2) sample answers and (3) pair-wise comparison question items. The scale is defined as '1: Equal', '3: Moderate importance', '5: Strong importance', '7:Very strong importance', '9: Extreme importance' and '2,4,6,8 :Intermediate'.

Table 1. The pairwise comparison of two groups

	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
A					V													B
B											V							C
C			V															D
D															V			E

In the pairwise comparison (see table 1), when comparing "A" and "B", the left side 5 is selected, indicating that "A" is more important than "B". As for the comparison between "B" and "C," 3 is selected on the right, indicating that "B" is of more importance than "C". As for the comparison between "C" and "D", 7 is selected on the left, indicating that "C" is very strongly important than "D". Comparing "D" and "E", the right side 7 is selected, indicating that "E" is very strongly important than "D".

**Step 2:** Enter and Calculate Data: convert the above answer questionnaire to Excel data file as below (see table 2).

Table 2. The matrix data in the Excel file

	A	B	C	D	E
A	1	5			
B		1	1/3		
C			1	7	
D				1	1/7
E					1

**Step 3:** Perform CFPR AHP Calculation

A fuzzy preference relation P on a set of alternatives A is a set on the product set A×A with membership function  $\mu_p : A \times A \rightarrow [0, 1]$ . The fuzzy preference relation is represented by the n×n matrix  $P=(p_{ij})$ , where  $p_{ij}=\mu_p(a_i,a_j)$  for every  $i, j \in \{1, \dots, n\}$ . Here,  $p_{ij}$  is the preference ratio of alternative  $a_i$  to  $a_j$ ;  $p_{ij}=1/2$  means that no difference exists between  $a_i$  and  $a_j$ ,  $p_{ij}=1$  indicates that  $a_i$  is absolutely better than  $a_j$ , and  $p_{ij}>1/2$  indicates that  $a_i$  is better than  $a_j$ . In this case, the fuzzy preference matrix P is generally assumed to be an additive reciprocal,  $p_{ij} + p_{ji} = 1$  for every  $i, j = 1, \dots, n$ . Chen and Lee [4]. The proposition of the consistent fuzzy preference relation as below.

Proposition 1. Consider a set of alternatives,  $A=\{a_1, \dots, a_n\}$ , associated with a reciprocal multiplicative preference relation  $A=(a_{ij})$  for  $a_{ij} \in [1/9, 9]$ . Then, the corresponding reciprocal fuzzy preference relation,  $P=(p_{ij})$  with  $p_{ij} \in [0, 1]$  associated with A is given as  $p_{ij} = g(a_{ij})=(1/2)(1 + \log_9 a_{ij})$ .

Proposition 2. For a reciprocal fuzzy preference relation  $P=(p_{ij})$ , the following statements are equivalent:

$p_{ij} + p_{jk} + p_{ki} = (3/2)$ , for every  $i, j, k$ .  $p_{ij} + p_{jk} + p_{ki} = (3/2)$ , for every  $i < j < k$ .

$p_{ij} + p_{jk} + p_{ki} = (3/2)$ , for every  $i < j < k$ .  $p_{i(i+1)} + p_{(i+1)(i+2)} + \dots + p_{(j-1)j} + p_{ji} = (j-i+1)/2$ , for every  $i < j$

Proposition 3. If a decision matrix P with entries that are not in the interval [0, 1], but in an interval  $[-m, 1 + m]$ ,  $m > 0$  can be obtained by transforming the obtained values using a transformation function that preserves reciprocity and additive consistency. We can get the new fuzzy preference relation P' that is obtained as  $P'=f(P)$ , The function  $f : [-m, 1 + m] \rightarrow [0, 1]$ ,  $f(x)=(x+m)/(1+2m)$ . The fuzzy preference relation A is obtained as  $A=f(P)$  such that  $A=(a_{ij})$ ,  $a_{ij}=9^{2p'_{ij}-1}$ . Therefore, it can obtain the sum of every row in matrix A' using  $r_i = \sum_{j=1}^n (a'_{ij})$ . Then we can obtain the weight of each item by  $W_i = r_i / \sum_{i=1}^n (r_i)$ .

On the other hand, if a decision matrix P with entries that are in the interval [0, 1], we directly use the fuzzy preference relation  $A=f(P)$  such that  $A=(a_{ij})$ ,  $a_{ij}=9^{2p'_{ij}-1}$ . Then, it can obtain the sum of every row in matrix A using  $r_i = \sum_{j=1}^n (a_{ij})$ . Then we can obtain the weight of each item by  $W_i = r_i / \sum_{i=1}^n (r_i)$ .

## 4 Result

This study collected seven industry experts' questionnaires, with an average age of 51.4 years and an average of 32.7 years of industrial seniority. All results output after entering all the questionnaire data, we can get the result chart, which shows the final number, including the weights and rank of each item. This study is mainly aimed at finding out the key factors of the educational training model of the bakery industry in Taiwan. According to the CFPR AHP geometric average results, the weights and order of all activities are as follows (Table 3).

Table 3. The weights and order of all activities

Classification	Weight	Ranking
A. Course Design	0.070	5
B. Teaching Staff	0.205	3
C. Learning Environment	0.159	4
D. Cultural Awareness	0.242	2
E. Creativity	0.320	1

According to the above weighted rankings, the key dimensions of the educational training module in Taiwanese bakery industry in order are (E) Creativity, (D) Cultural Awareness, (B) Teaching Staff, (C) Learning Environment, and (A) Curriculum Design.

## 5 Conclusion

The purpose of this research is to construct the educational training model of the Taiwanese bakery industry. We use an innovative approach, called the consistent fuzzy preference relation analytic

hierarchy process (CFPR AHP), to construct the educational and training model. The CFPR AHP approach that can solve the inconsistent problem of AHP and relieve the questionnaire burden of the respondents is better than the approach of the traditional AHP. Based on the questionnaire opinions of the industry experts, the CFPR AHP results show that the more important constructs of educational training model of the Taiwanese bakery industry are creativity, cultural awareness, and teaching staff. Moreover, the more important items are originality, master-apprentice ethics, multicultural experience, good teaching performance, creative thinking skill, good teaching equipment and interdisciplinary learning (see table 4).

With regard to the educational training model of the Taiwanese bakery industry for students, the most important item is originality, similar to Horng [8], who proposed originality relevance in the creation of technical vocational education. This study explored the educational training model from the perspective of industry. We recommend that follow-up studies focus on the academic perspective on the educational training model and compare with the results we found here. Moreover, the use of CFPR AHP method here solves the relatively inconsistent problem of traditional AHP analysis. It is worth mentioning that the CFPR AHP method reduces a large number of pairwise comparisons. This method also reduces the time for experts to fill out questionnaires; at the same time, and increases the reliability and validity of the questionnaires.

Table 4. The weight and ranking of every item of the educational training model

		Weight	Ranking
A. Curriculum design			
a1	The course structure has a good design	0.0231	17
a2	The curriculum is practical and professional	0.0284	14
a3	The course is valuable	0.0234	16
B. Teaching staff			
b1	Promote students actively to participate in learning	0.0397	10
b2	Focus on student thinking and learning style	0.0301	12
b3	Has good level of knowledge	0.0506	8
b4	Has good teaching performance	0.0841	4
C. Learning environment			
c1	Comfortable environment	0.0142	20
c2	Safe place	0.0287	13
c3	Good teaching equipment	0.0513	6
c4	Popular computer equipment	0.0244	15
c5	Friendly learning atmosphere	0.0401	9

D. Cultural awareness

d1	Appropriate communication styles	0.0195	18
d2	Attentiveness	0.0175	19
d3	Developing creative thinking skill	0.0606	5
d4	Originality	0.1446	1

E. Creativity

e1	Emphasize the ethics of master and apprentice	0.1169	2
e2	Focus on multivariate experience	0.1128	3
e3	Focus on interdisciplinary learning	0.0512	7
e4	Emphasize culture diversity	0.0388	11

References:

- [1] Bozoki, S. & Rapcsak, T., On Saaty's and Koczkodaj's inconsistencies of pairwise comparison matrices, *Journal of Global Optimization*, Vol. 42, No.2, 2008, pp. 157-175.
- [2] Brassler, M. & Dettmers, J., How to Enhance Interdisciplinary Competence— Interdisciplinary Problem-Based Learning versus Interdisciplinary Project-Based Learning, *Interdisciplinary Journal of Problem-Based Learning*, Vol.11, No.2, 2017, pp.7-31.
- [3] Chen, C. L., *Organizational Learning : A Case Study for International Tourist Hotels' Bakers*, Unpublished Thesis, Department of Baking Technology and Management, National Kaohsiung University of Hospitality and Tourism Republic of China , 2010.
- [4] Chen, C. A. & Lee, H L., The Taiwanese Businessman Assess The Investment Environment of China– Construction and Application of PR AHP Program, *Asian Economic and Financial Review*, Vol.5, No.8, 2015, pp.988-1003.
- [5] Devine, F., Baum, T., & Hearn, N., Resource Guide: Cultural Awareness for Hospitality and Tourism, *Hospitality, Leisure, Sport and Tourism Network*, 2009, pp.1-16.
- [6] Gruber, T., Fub, S. V. R, & Glaser-Zikuda, M., Examining student satisfaction with higher education services, *International Journal of Public Sector Management*, Vol.23, No.2, 2010, pp.105–123.
- [7] Herrera-Viedma, E. F., Herrera, F. C., & M. Luque, M., Some issues on consistency of fuzzy preference relations, *European Journal of Operational Research*, Vol.154, No.1, 2004, pp.98-109.
- [8] Horng, J. Y., The Construction of Inventory for Culinary Creativity Process, *Bulletin of Educational Psychology*, Vol.39, 2009, pp.1-20
- [9] Hu, M. L., Chen, L.C., & Lin, L., The comparative study of the culinary curriculum between Taiwan and USA, *Journal of Culinary Science & Technology*, Vol.5, No.2-3, 2006, pp.93-107
- [10] Jeffrey, B. & Craft, C., Teaching creatively and teaching for creativity: distinctions and relationships, *Educational Studies*, Vol.30, No.1, pp.77–87.
- [11] Jing, H., *Coupled with the civilian price of baked goods appealed to the preference*. Unpublished Thesis, Department of Baking Technology and Management, Tourism College, Jingwen University of Technology, Republic of China, 2015.
- [12] Ju, Y. & Wang, A., Emergency alternative evaluation under group decision makers: A method of incorporating DS/AHP with extended TOPSIS, *Expert Systems with Application*, Vol.39, No.1, 2012, pp.1315-1323
- [13] Letty, Y., Kwan, Y., Leung, K. Y. & Liou, S. H., Culture, Creativity, and Innovation. *Journal of Cross-Cultural Psychology*, Vol.49, No.2, 2018, pp.165-170.
- [14] Macharis, C., Springael J., De Brucker, K., & Verbeke, A., Promethee and AHP: The design of operational synergies in multicriteria analysis. Strengthening Promethee with ideas of AHP, *European Journal of Operational Research*, Vol.153, 2004, pp.307–317.
- [15] UNESCO-UNEVOC, *UNESCO's Strategy for Technical and Vocational Education and Training, 2016-2021*, 2019.
- [16] Wang, L.W., *Application of AHP Theory on the Evaluation of Excellent Teacher*. Unpublished Thesis, Chung Hua University, 2011