

STRATEGIES OF PROFESSIONAL DEVELOPMENT FOR THE EFL TEACHERS IN ELEMENTARY SCHOOLS

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ABSTRACT. *How to effectively evaluate and facilitate teachers' professional development has become a major concern. In this paper, we make a detailed analysis with the fuzzy statistics and soft computing methods for the fuzzy questionnaires. Using the membership function and fuzzy statistical analysis, we find the data may contribute to our understanding of the expressions under human cognition which is not easily shown. Depended on the findings from the current status and needs of English teachers' professional development, we provide suggestions for the enhancement of in-service English teachers and teacher education in an EFL context.*

Keywords: Professional Development; EFL Teachers; Fuzzy Statistical Analysis

1. Introduction. As English has been viewed as the lingua franca or English as international language (EIL), Jenkins(2006) and Ur(2009), one of the possible impacts was that many Asian countries conducted the policy of teaching English in elementary schools. The general assumption is that English ability represents competitiveness and internationalization. Under this premise, the quality of teacher workforce plays a critical role. The pursuit of raising teacher quality may have direct effects on students and school performance and indirectly affect the policy direction for enhancing student achievement, OECD (2005). In order to facilitate continuous teachers' professional development, the educational authorities or policy makers ought to provide concise directions for teachers, OECD (2010).

However, there are few studies have focused on investigating how to evaluate elementary English teachers' ability and their need for in-service education in English as a foreign language (EFL) context. Without authentic evaluation of teacher's need and ability, the policy or programs provided by the government might not be suitable for teachers.

Teachers' profession involves a wide range of elements, such as knowledge and ability, disposition, ethnics, organization and development and so on. Teachers are in the vanguard of teaching and the reformer of education innovation at school. If we enhance teachers' professional development, teachers would become the main assets in schools.



The National Council for Accreditation of Teacher Education (NCATE) (NCATE, 2002) approved and promulgated the professional standards for schools and educational institutions. They suggest that the development of teachers' professional knowledge and capacity should include the mastery of the subject matter that they plan to teach, basic knowledge of education, teaching theory and the increase of teaching practice capacity.

However, different subject areas of teacher professional development should have their special characteristics. Interstate New Teacher Assessment and Support Consortium (INTASC) (INTASC,2002) proposes that a good EFL teacher should process the following skills: 1.Content knowledge; 2. Learner development; 3. Diversity of learners; 4. Instructional strategies; 5. Learning environment; 6. Communication; 7. Planning for instruction; 8. Assessment; 9. Reflective practice and Professional development; 10. Community.

According to the discussion above, the researchers define that the "professional development" of English teachers includes personal English ability, special knowledge about English, cultural knowledge of English and general teaching ability.

Within research area of social science, qualitative studies conduct statistics to simply and rapidly describe the basic structure of data. However, most of the events and phenomena, such as language, thinking, and decision making, consist of ambiguity and non-quantified features. Human behaviors particularly contain many equivocal preferences. Under the circumstances, Zadeh's fuzzy set theory can convey human's thinking more realistic than other method Wu and Ho (2008). Zadeh (1965) argued that human's brain utilizes fuzzy evaluation and categorization toward dynamic environment. By the principles, researchers can provide solutions with more stable illustration to multiple and complicated ambiguous phenomena. Fuzzy statistics can improve the limitations that subjects' answer has been narrowed by traditional questionnaire of binary logic approach. The fuzzy weight is defined between 0 and 1. If the importance is much higher, the weight value will be much closer to 1. On the contrary, the weight value will be much closer to 0. The soft computing makes researchers analyze more precisely than crisp statistics.

In recent years, more and more researchers utilized the fuzzy statistical analysis and applications in the fields of social science. For instance, Wu and Sun (2001) demonstrated the concepts of fuzzy statistic and applied it to social survey; Wu and Tseng (2002) used fuzzy regression method of coefficient estimation to analyze Taiwan monitoring index of economic. Moreover, Wu and Hsu (2004) identified the model construction through qualitative simulation. For an extensive treatment of the theory of fuzzy statistics the interested reader may refer to see Nguyen and Wu (2006).

In the study, we implemented fuzzy questionnaire survey and soft computing method to discuss evaluation and strategies for elementary EFL teachers' professional development in Taiwan. According to the former statement, the main purposes of the study are as follows:

- (1)Supply dimension: discuss the current status of English teachers' professional competences in elementary school in Taiwan.
- (2)Need dimension: discuss the need of English teachers' professional development in elementary school in Taiwan.
- (3)Dynamic balance dimension: discuss the background variables of English teachers'



professional development in terms of sex, age, position, educational background, certification, school size, and seniority.

(4) Strategic dimension: To cope with fewer children and internationalization, the study reexamines strategies for EFL English teachers' professional development.

2. Evaluation for Teachers' Professional Development.

2.1. Research Procedure. In order to give a systematic analysis for the EFL teachers' evaluation we propose the following procedure:

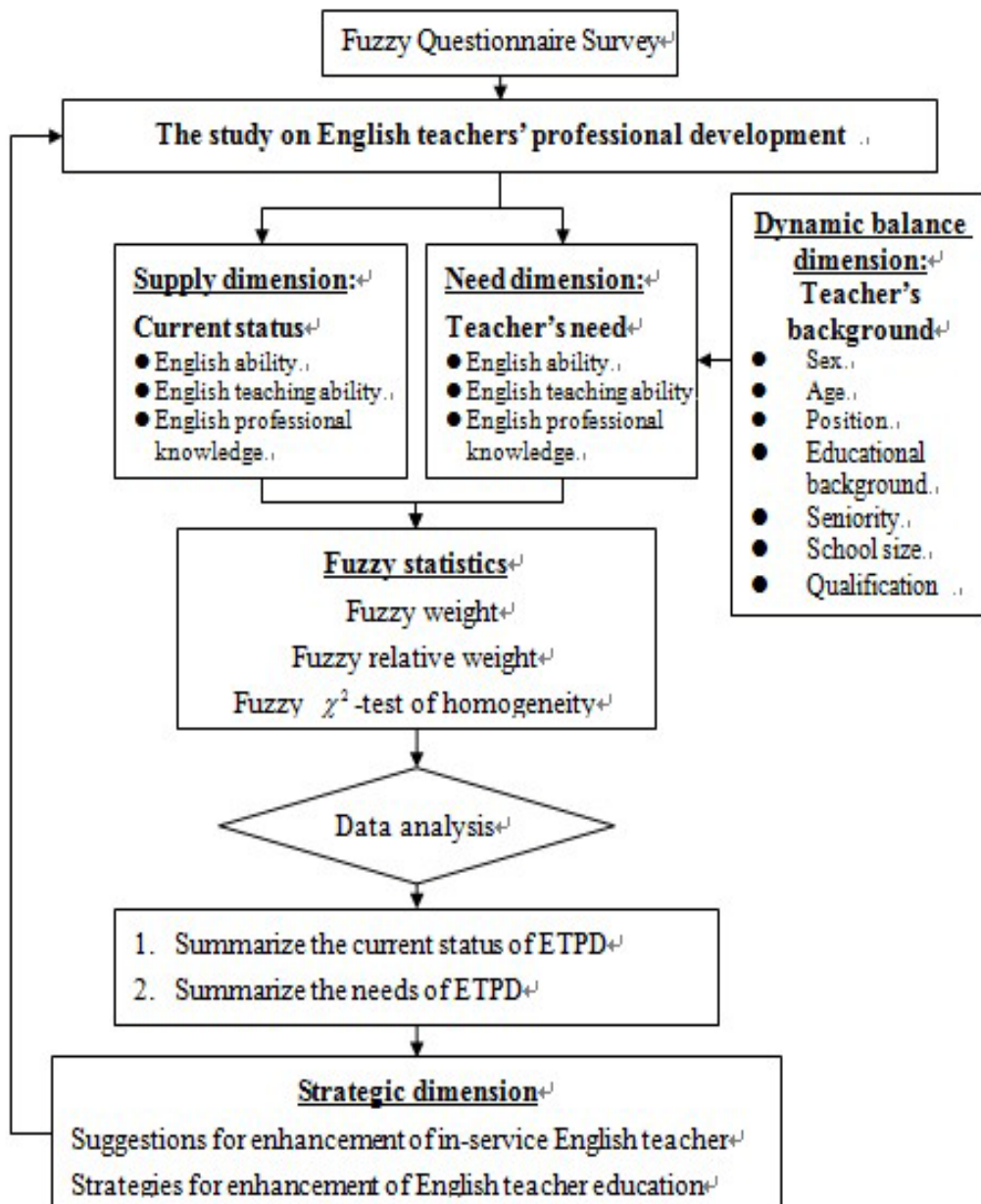


FIGURE 1. Research procedure



2.2. Membership Measure and Fuzzy Statistic. Membership statistics differs from traditional statistics in terms of logic concepts and frameworks. Teachers' need on English professional knowledge of culture listed in Table 1.

TABLE 1. Teachers' need on English professional knowledge of culture

	English culture	English children literature	English drama & movie	Internationalization education
Teacher		0.5	0.2	0.3

In this example, we consider the universe set $X = \{\text{English teacher}\}$, one of the element in X is x , and defined as some professional development, let membership set of X , $F = \{\text{English professional knowledge of culture}\}$, the cut of F set $\{C_1, C_2, C_3, C_4\} = \{\text{English culture, English children literature, English drama & movie, Internationalization education}\}$.

According to traditional statistics, the arithmetic is 1 point for 1 item. The subject can only choose one of the four choices. The answer can't display the relationships among the choices. If we use fuzzy statistics, the subject can completely express the ambiguous phenomenon in his or her mind. The results are closer to real situation than the traditional method and follow the rule "1 point for 1 item."

In traditional statistics, mean score is presented by point, so it's called point estimation. However, in fuzzy statistics, the data are fuzzy intervals. We use interval to display the centralized trend of data. The arithmetic ideas are based on related definitions of traditional statistics. On the other hand, for the same subject, the value obtained by traditional questionnaire must be included in the fuzzy interval that obtained by fuzzy questionnaire of the same question. Therefore, these two kinds of data to some extent possess correlation. Related concepts of fuzzy statistics using in this paper are illustrated as follows:

Definition 2.1. Fuzzy weight (FW). We consider universe of discourse $S = \{S_1, S_2, \dots, S_k\}$, utility sequence $r_1 < r_2 < \dots < r_f$, and S_i in r_f membership is $u_{s_i f}$. Then the Fuzzy weight $FW = (FW_{s_1}, \dots, FW_{s_k})$ is defined as:

$$FW_{s_i} = \frac{\sum_{l=1}^f \mu_{s_i l}}{r_i} = \frac{\mu_{s_i 1}}{r_1} + \frac{\mu_{s_i 2}}{r_2} + \dots + \frac{\mu_{s_i f}}{r_f}; i = 1, \dots, c. \quad (1)$$

In the fuzzy set, membership ranges from 0 to 1, and every language variable, such as shape, represents a possible distribution. The results of the distribution might be different from different subjects. We can average the answers from the subjects to make the utility sequence r of universe of discourse S membership u_s reasonable distribution (Wu, 2005).

Definition 2.2. Fuzzy relative weight analysis. If we consider utility sequence $r = \{r_1, r_2, \dots, r_f\}$, then define $r_1 < r_2 < \dots < r_f$ as utility increasing sequence; otherwise, $r_1 > r_2 > \dots > r_f$ is utility decreasing sequence.

According to the sort of utility sequence, the computing of the fuzzy relative weight is: Consider universe of discourse $S = \{S_1, S_2, \dots, S_k\}$, utility sequence $r = \{r_1, r_2, \dots, r_f\}$, and



$\mu_{S_i f}$ is the membership of r_f in S_i . Then the fuzzy weight for element of universe of discourse $FW = \{FWS_1, \dots, FWS_k\}$ is defined as:

$$FW_{S_i} = \sum_{l=1}^f \mu_{S_i l} / r_l + \mu_{S_i 1} / r_1 + \mu_{S_i 2} / r_2 + \dots + \mu_{S_i f} / r_f ; i = 1, \dots, c \quad (2)$$

2.3. Fuzzy χ^2 -Test of Homogeneity (with Discrete Data). Consider a K-cell multinomial vector $n = \{n_1, n_2, \dots, n_k\}$ with $\sum_i n_i = n$. The Pearson chi-squared test ($\chi^2 = \sum_i \sum_j \frac{n_{ij} - e_{ij}}{e_{ij}}$) is a

well known statistical test for investigating the significance of the differences between observed data arranged in K classes and the theoretically expected frequencies in the K classes. It is clear that the large discrepancies between the observed data and expected cell counts will result in larger values of χ^2 .

However, a somewhat ambiguous question is whether (quantitative) discrete data can be considered categorical and use the traditional χ^2 -test. For example, suppose a child is asked the following question: “how much do you love your sister?” If the responses is a fuzzy number (say, 70% of the time), it is certainly inappropriate to use the traditional χ^2 -test for the analysis. Wu (2005) presents a χ^2 -test for fuzzy data as follows:

2.3.1. Procedures for Testing Hypothesis of Homogeneity for Discrete Fuzzy Samples.

- (1) Sample: Let Ω be a domain, $\{L_j, j = 1, \dots, k\}$ be ordered linguistic variables on Ω , and $\{a_1, a_2, \dots, a_m\}$ and $\{b_1, b_2, \dots, b_n\}$ are random fuzzy sample from population A, B with standardized membership function mA_{ij}, mB_{ij} .
- (2) Hypothesis: Two populations A, B have the same distribution ratio. i.e

$$H_0 : F\mu_A =_F F\mu_B$$

Where

$$F\mu_A = \frac{1}{m} \frac{MA_1}{L_1} + \frac{1}{m} \frac{MA_2}{L_2} + \dots + \frac{1}{m} \frac{MA_k}{L_k}$$

$$F\mu_B = \frac{1}{n} \frac{MB_1}{L_1} + \frac{1}{n} \frac{MB_2}{L_2} + \dots + \frac{1}{n} \frac{MB_k}{L_k}$$

$$MA_j = \sum_{i=1}^m mA_{ij}, MB_j = \sum_{i=1}^n mB_{ij}$$

- (3) Statistics: $\chi^2 = \sum_{i \in A, B} \sum_{j=1}^c \frac{([Mi_j] - e_{ij})^2}{e_{ij}}$. (In order to perform the Chi-square test for fuzzy data, we transfer the decimal fractions of Mi_j in each cell of fuzzy category into the integer Mi_j by counting 0.5 or higher fractions as 1 and discard the rest.)
- (4) Decision rule: under significance level α , if $\chi^2 > \chi^2_{\alpha}(k - 1)$, then we reject H_0 .



2.3.2. Procedures for Testing Hypothesis of Homogeneity for Interval Fuzzy Samples.

(1) Sample: Let Ω be a discussion domain, $\{L_j, j=1, \dots, k\}$ be ordered linguistic variables on the total range of Ω , and $\{a_i = [a_{li}, a_{ui}], i=1, \dots, m\}$ and $\{b_i = [b_{li}, b_{ui}], i=1, \dots, n\}$ and are random fuzzy sample from population A, B with standardized membership function mA_{ij}, mB_{ij} .

(2) Hypothesis: Two populations A, B have the same distribution ratio. i.e

$$H_0 : F\mu_A = F\mu_B$$

Where

$$F\mu_A = \frac{1}{m} \frac{MA_1}{L_1} + \frac{1}{m} \frac{MA_2}{L_2} + \dots + \frac{1}{m} \frac{MA_k}{L_k}$$

$$F\mu_B = \frac{1}{n} \frac{MB_1}{L_1} + \frac{1}{n} \frac{MB_2}{L_2} + \dots + \frac{1}{n} \frac{MB_k}{L_k}$$

$$MA_j = \sum_{i=1}^m mA_{ij}, MB_j = \sum_{i=1}^n mB_{ij}.$$

(3) Statistics: $\chi^2 = \sum_{i \in A, B} \sum_{j=1}^c \frac{([Mi_j] - e_{ij})^2}{e_{ij}}$. (In order to perform the Chi-square test for fuzzy

data, we transfer the decimal fractions of Mi_j in each cell of fuzzy category into the integer Mi_j by counting 0.5 or higher fractions as 1 and discard the rest.)

(4) Decision rule: under significance level α , if $\chi^2 > \chi_{\alpha}^2(k-1)$, then we reject H_0 .

Example 2.1. The educational authority wants to know the degree of effectiveness from an English teacher training program. Suppose they are interested in how the sex will make a difference about the curriculum. They conduct a sampling survey and ask the people with two methods for reply: traditional reply and fuzzy reply. The results are as follows:

TABLE 2. Replies for teachers on the degree of curriculum effectiveness

Category	Effectiveness of curriculum			Effectiveness of curriculum		
	Professiona 1	Cultura 1	Instructiona 1	Professiona 1	Cultura 1	Instructiona 1
Male	220	280	100	216.2	268.5	114.3
Female	170	150	80	158.1	154.7	87.2
χ^2 -test of homogeneity	$\chi^2 = 8.27 > 5.99 = \chi_{0.05}^2(2)$			$\chi^2 = 3.78 < 5.99 = \chi_{0.05}^2(2)$		

Null Hypothesis: H_0 : there is no difference of the degree of effectiveness for sexes. H_1 : there is no difference of the degree of effectiveness for sexes. Under the significance level $\alpha = 0.05$, we can find that there exists difference. Statistical testing conclusion: for traditional reply, we will reject the null hypothesis. While for the fuzzy reply, we will accept the null hypothesis.



Example 2.2. In order to set up a professional development strategy, the research center of English teacher education wants to know the studying expense (monthly) between school X and school Y. They randomly choose 50 samples from X and Y. during the answering process, teachers are asked to write their studying expense by interval instead of real number. For instance, they can write the studying expense as: 1500~2500 with membership 0.7, 2500~4000 with membership 0.3. Then they sum up the memberships and get the following Table 3

TABLE 3. Monthly studying expense for school X and Y

	0~1500	1500~2500	2500~4000	4000~6000	6000+
X	2.8	10.3	19.7	14.2	5.0
Y	7.1	21.6	20.9	6.8	2.6

Null Hypothesis H_0 : The distribution (ratio) for studying expense between school X and Y has no difference. H_1 : School X has a higher living studying than Y.

Computing the statistics χ^2 , we find $\chi^2 = 8.43 > \chi^2_{0.05}(4) = 7.78$. Hence under the significant level $\alpha = 0.1$. We reject H_0 : The distribution (ratio) for studying expense between is no difference. Examining again the data, we may say that the school X has a higher studying expense than school Y.

3. Empirical Analysis and Discussion. This section discussed the results on English teachers’ professional development in terms of supply, need, dynamic balance, and strategies.

TABLE 4. The membership of current status on English teachers’ professional competences

	Excellent	Very well	Well	Not so good	Poor
English ability	0.01	0.90	1.81	1.19	0.18
English professional knowledge	0.00	0.89	1.46	1.18	0.49
English Cultural knowledge	0.05	1.12	1.21	1.20	0.43
English teaching ability	0.39	2.20	1.27	0.39	0.10
Whole ability	0.41	5.78	7.81	5.13	1.44

3.1. Supply Dimension: the Current Status of English Teachers’ Professional Competences. Table 4 presents the sum of membership on different language variables with respects to English ability (four skills) and English professional knowledge, including phonetics, syntax, morphology, and pragmatics. As for English ability, most of the distributions lie on “well” and “not so good”, while English teaching ability displays higher distribution of membership on “very well.”



Table3.2 shows that several background variables, including “school size”, “educational background”, and “qualification”, reach significant differences on “English ability”, “English cultural knowledge”, ” English teaching ability.”

TABLE 5. The differences of current status on English teachers’ professional competences

	English ability	English professional knowledge	English cultural knowledge	English teaching ability
Sex				
Age				
School size			**	
Educational background			**	**
Seniority				
Position				
Qualification	**		***	*

*** p<.01, **p<.05, *p<.1

TABLE 6. The membership of English teachers’ need for professional development

English ability	Listening	Speaking	Reading	Writing	-
	0.34	0.42	0.10	0.15	-
English professional knowledge	Phonetics	Syntax	Morphology	Pragmatics	SLA
	0.21	0.19	0.15	0.23	0.22
English cultural knowledge	English culture	English children literature	English drama & movie	Internationalization education	-
	0.18	0.40	0.15	0.27	-
English teaching ability	Curriculum design	Teaching method	Evaluation	Application of teaching recourses	-
	0.28	0.33	0.12	0.27	-

3.2. Need Dimension: English Teachers’ Needs for Professional Development. Table3.3 expresses the membership for sub-categories of professional development with respect to teachers’ need. At English ability level, teachers reveal higher membership on listening and speaking ability. At English professional knowledge level, the distribution is about average. As for English cultural knowledge, teachers have greater needs for children literature and internationalization education. For English teaching ability, the sequential needs are teaching method, curriculum design, application of teaching recourses, and evaluation.



3.3. Dynamic Balance: the Evaluation of Different Backgrounds. Table 7 displays the results from fuzzy χ^2 -test of homogeneity toward the differences of needs for professional competences among English teachers in Taiwan.

TABLE 7. The differences of needs for English professional competences

	English ability	English professional knowledge	English cultural knowledge	English teaching ability
Sex		***		
Age				
School size		***	**	
Educational background				*
Seniority		***	*	
Position			***	
Qualification	***			

*** p<.01, **p<.05, *p<.1

TABLE 8. Membership of needs for improving English ability

Qualification	Listening	Speaking	Reading	Writing	χ^2 -test of homogeneity
major/minor in English related departments	3.5	4.6	1.1	3	$\chi^2_{0.05}(3)=12.75$ > 7.81
English training program run by county or city bureaus	6.4	7.9	2	1.7	

TABLE 9. The membership of needs for English professional knowledge

		Phonetics	Syntax	Morphology	Pragmatics	SLA	χ^2 -test of homogeneity
Sex	Male	3.7	1.7	1.1	1.2	2.2	$\chi^2_{0.05}(4)=28.97$ >9.48
	Female	2.5	4	3.4	5.6	4.6	
School size	6~24	3.3	2.5	1.5	2.2	1.4	$\chi^2_{0.05}(4)=16.97$ >9.48
	24~	2.9	3.2	3	4.6	5.4	
Seniority	0~5	1.6	1.5	1.1	0.9	1	$\chi^2_{0.05}(8)=32.54$ >15.50
	6~10	3.3	2.4	2.7	3.6	4.9	
	11~20	1.3	1.8	0.7	2.3	0.9	



3.3.1. The Needs for Improving English Ability. According to Table 3.4, teachers with certificate by county or city bureaus have greater needs on improving their listening and speaking ability than those of major/minor in English related departments.

3.3.2. The Needs for English Professional Knowledge. In Table 9, male English teachers have greater needs on phonetics, whereas female teachers show their needs on syntax, morphology, pragmatics, and second language acquisition (SLA). Teachers in schools of more than 24 classes prefer pragmatics and SLA, while those in small school size prefer phonetics and syntax.

3.3.3. The Needs for English Cultural Knowledge. Table 10 reveals that teachers of different position, seniority, and school size express high needs for English children literature, internationalization.

TABLE 10. Membership of needs for English cultural knowledge

		English culture	English children literature	English drama & movie	Internationalization education	χ^2 -test of homogeneity
School size	6~24	1.3	5.1	1.4	3.2	$\chi^2_{0.05}(3)=8.51 > 7.81$
	24~	4.4	7.2	3.3	4.1	
Seniority	0~5	1.1	2.9	1.1	0.9	$\chi^2_{0.1}(6)=11.34 > 10.64$
	6~10	4	6.2	2.4	4.4	
	11~20	0.6	3.2	1.2	2	
Position	Subject	3.2	3.5	1.8	3.5	$\chi^2_{0.05}(3)=14.99 > 7.81$
	Home	2.5	8.8	2.9	3.8	

3.4. Strategic Dimension: EFL Teachers' Professional Development Strategies Reacting to Fewer Children and Internationalization. Depended on the research results above, the strategies for English teacher professional development are as follows:

3.4.1. Establish Certification and Reward System for English Teacher Professional Development.

- (1) Build up evaluation indicators for English teacher and researcher references.
- (2) Set up cloud management platform to monitor human capital development.
- (3) Establish reward system for in-service learning, teaching and professional seminar to promote the positive interaction and development for English teachers.

3.4.2. Strengthen the Shortages of Teachers' Competence, and Enhance the Advantages to Be Excellent.

- (1) Develop English teacher professional community in each area.
- (2) Improve teachers' ICT (information communication technology) ability for a higher teaching and evaluating effects.
- (3) Utilize instruction advisory team at central and local level to promote school teachers' competence.



3.4.3. Cross Country Cooperation on English Teacher Professionalism and Culture.

- (1) Invite international scholars and excellent English teachers to long stay in Taiwan.
- (2) Select teachers with high potential to study and train abroad.
- (3) Utilize International Exchange Program for teachers to enhance international education competence.

3.4.4. Cooperate with Higher Education to Facilitate English Teachers' Professional Development.

- (1) Build up local English teaching research center to conduct the short, mid, long term studies in Taiwan.
- (2) Provide multiple in-service programs according to teachers' need.
- (3) Examine and modify the structure of curricular for English teacher in high education to suit the future requirement.

4. Conclusion. Taiwan belongs to EFL context, and the success of English education need multi-dimensional cooperation and endeavor. The professional development of English teacher is the assurance for quality English teacher. Only via ongoing estimating, monitoring, and checking teachers' ability and need can we effectively catch the core of teachers' professional development. The study is the first step to establish a framework for evaluating English teachers' professional development. We focus on different subjects, such as secondary English teachers, extend the geographical area, compare with other countries, and conduct longitudinal studies. Hopefully, our efforts to construct a database will help English teachers' professional development in the future.

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