Study on Key Factors Improving Self-efficacy of Agro-food Education-A Case Study on Taiwan Jhonghe Elementary School

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Abstract- In recent years, unsafe food events have occurred in various places of Taiwan. In order to address this issue fundamentally, schools are actively promoting agro-food education. Agro-food education enables children to learn the original flavor of food and develop the awareness of healthy diet. This study aimed to raise the self-efficacy of agro-food education. It collected opinions of anonymous experts through a questionnaire, combined literature review with the results of interviews with the experts, proposed a Delphi questionnaire, and created decision-making hierarchy. Moreover, it investigated high-grade students of middle and elementary schools. Finally, through Analytic Hierarchy Process (AHP), it concluded the weights of factors which could improve the self-efficacy of agro-food education.
The results of this study found that, among the primary criteria affecting key factors, the experts attached the highest importance to the dimension of self-efficacy of diet followed by the dimension of self-efficacy of learning. Among the secondary criteria, intake of vegetables, basic abilities, and nutrition labeling are extremely vital. Hence, the factors related to the dimensions of self-efficacy of diet and learning have a certain influence on agro-food education. Such influences are consistent and continuous. And these factors influence the most important factors that affect the improvement of self-efficacy of middle and elementary school students.

Keywords: agro-food education, self-efficacy of learning, Delphi questionnaire, Analytic Hierarchy Process

I. INTRODUCTION

In 2015, Lovely Taiwan Foundation launched "Shennong Program". Starting from Miaoli, it program centers on "organic diet, land education, and hometown identity". Starting from organic diet, the program helps children cultivate the habit of organic and healthy diet and strengthen their physique. It advocates "One Mu of Field in One School" (1 mu is equivalent to 666.7m2.) and regards field as classroom. By standing on soil and sowing seeds, students are expected to learn the land of Taiwan and environmental sustainability and increase their identity and confidence of their hometown. The plan intended to change the general nutrition lunches of 11 elementary schools in Miaoli and 4 in Pingtung to an organic vegetable diet for three years. Wen-chang Ko, the Chairman of Lovely Taiwan Foundation, invited 10 companies to work together to subsidize the difference between the two types of meals, provide on-campus organic farming courses and off-campus farm experiential learning, and set up hands-on learning based on fields and farms of the schools. Jhonghe Elementary School participated in this agro-food education program. The key to render the most important learning outcome to students is to stress environmental friendly farming methods and local food with minimum chemical additives through hands-on experience in farming and food production.

II. LITERATURE REVIEW

This chapter includes literature review and analysis. By analyzing literature and relying on relevant theories, this study on key factors enhancing the self-efficacy of agro-food education was conducted.

A. Agro-food education

Through interviews with experts and scholars in various areas, Tung & Tsai (2016) defined "agro-food education as a type of experiential education emphasizing learning via hands-on experience.

Participants take part in the whole process of agricultural products, from production, processing, to cooking, and develop simple farming skills.

B. Experiential learning

Experiential learning is a way of education in which participants reflect life and environment and learn knowledge through firsthand experience.

The constructive view of experiential learning lies in that, starting from themselves and based on firsthand experience and reflection, students are expected to learn from experience and improve their ability to grow (Hsieh, Wu, & Hsieh, 2007).

C. Self-efficacy

The term "self-efficacy" was created by Psychologist Albert Bandura. Bandura's social cognitive theory (SCT) (1986) emphasizes that relevant knowledge and skills are still not enough for individuals to generate behaviors. Also, they must have enough confidence and believe that they can perform relevant tasks. In this way, personal behaviors can be generated or changed.

D. Self-efficacy of diet

Wu (2010) probed into self-efficacy of diet and covered the items like "intake of vegetables" and "attention to nutrition labeling during purchase of food". These items are consistent with diet education courses in agro-food education. Therefore, this study referred to the scale of self-efficacy of diet of Wu (2010) and modified it in line with special scenarios of agro-food education.

E. Self-efficacy of learning

During the compilation of scale of self-efficacy of learning, this study referred to scales of measurement tools for self-efficacy of disciplines. The measurement dimensions in the scale of self-efficacy of learning of Physics of Lin et al. included understanding of concepts by learners, experimental operation ability, ability in applying disciplines to life, and ability in explaining concepts to others.

F. Social self-efficacy

While collecting social self-efficacy scales, this study mainly referred to those targeting at "groups". Li (2005) explored the influence of integration of experiential learning in the integrative activity learning area of middle school on the self-efficacy of students. The design of agro-food education curriculum stressed that, students were expected to complete tasks assigned by their teachers through teamwork. Li's curriculum design was similar to the agro-food education curriculum planning of this study. Thus, this study referred to the social self-efficacy scale of Li (2005) and modified it in line with special scenarios of agro-food education.

G. Modified Delphi Method

The term "Delphi Method/Technique" has been into different Chinese versions due to transliteration (Lin, 2014), (Fan, 2004), (Wang, 2007), (Hau, 2005). Experts are organized to express and exchange ideas so as to simplify complicated questionnaire procedures. Due to factors like time, manpower, and funds, some procedures can be modified or deleted in order to conduct a research more smoothly. This practice is called Modified Delphi Method/Technique. Delphi Method aims to reach a consensus on a topic among experts (Du, 2013).

H. Analytic Hierarchy Process (AHP)

For decision makers, hierarchical structure facilitates the understanding of things. AHP divides complex and unstructured situations into several components or an integer, sets hierarchical order, and assigns a value on importance to each variable based on subjective judgment. Through a series of judgments and statistics, the priority of each variable is determined to help decision makers think and obtain results (Chen, 2008).

III. PROPOSED ALGORITHM

This study was designated to improve the key factors improving the self-efficacy of agro-food education. It collected domestic relevant statistical data and literatures as well as theoretical models of experts and scholars, and selected senior teachers of relevant subjects of primary and middle schools. It adopted Modified Delphi Method-based questionnaire and AHP to develop steps to conduct the research on key factors improving the self-efficacy of agro-

food education, as shown in Figure 1. Lastly, it obtained the weight of each decisive factor, rank factors in line with their weights, and compiled this paper. The methods and steps of this study are described as follows:

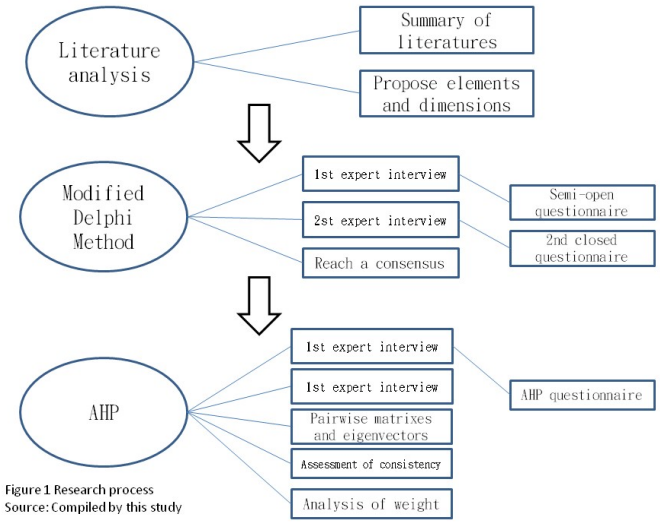

Figure 1 Research process

Step 1: First, literatures were analyzed to determine the research topic.

Step 2: Modified Delphi Method was adopted to develop assessment criteria.

According to the research questions, this study collected relevant domestic and foreign journals, literatures, statistical data, and laws and regulations, classified criteria into three aspects, that is, "self-efficacy of diet", "self-efficacy of learning", and "social self-efficacy", and determined the preliminary structure of assessment criteria.

Step 3: Design of Modified Delphi Method questionnaire.

First, the first round of Modified Delphi Method questionnaire was conducted, which was measured by semi-open Likert five-point scale. The questionnaire was distributed to senior teachers. Then, this study integrated relevant results to probe into the key factors increasing the self-efficacy of agro-food education. At this stage, the method of repeated questionnaire surveys was employed to obtain the opinions of experts. The results were integrated and analyzed till the opinions of all the experts reached a consensus. And the actual measurement ended.

Step 4: Analysis of data collected by the Modified Delphi Method questionnaire.

The factors whose average of importance was above 3.5 were screened out and regarded as the items of the final questionnaire. After the questionnaire was recovered and experts' opinions were collected, the items whose average was less than 3.5 were deleted.

Step 5: Design, distribution, and recovery of AHP questionnaire.

Step 6: Analysis of results of AHP questionnaire.

The analysis of AHP included three parts: Part 1 was the target layer. It was about the goal to be completed by this study, i.e. "self-efficacy". Part 2 covered the primary assessment criteria influencing decisive factors, including three dimensions: self-efficacy of diet, self-efficacy of learning, and social self-efficacy. Part 3 included the secondary criteria: The dimension of self-efficacy of diet included intake of vegetables, dietary habit, and dietary behavior. The dimension of self-efficacy of learning included five items, namely, basic abilities, explanation ability, planting ability, conditioning ability, and ability of equalization. The dimension of social self-efficacy covered five items, that is, interaction, cooperation, communication, confidence, and social contact.

Step 7: Decision analysis software was used to measure the weight of each indicator and establish the influencing factor selection table.

Step 8: Conclusions and suggestions were made based on the research results.

IV. Analysis and Discussion of Results

This study regarded from primary and middle school students as its subjects to investigate the key factors improving the self-efficacy of agro-food education. It collected, analyzed, and discussed data based on questionnaires and concluded the importance and influence of dimensions of self-efficacy of diet and learning.

A. Analysis of the results of the 1st Delphi Method questionnaire

(1) The items of "self-efficacy of diet" had favorable functionality. After discussion by experts, all these items were retained.

(2) In terms of the items of "self-efficacy of learning", as students might not have the opportunity to practice cooking at home, the item of "conditioning ability" was deleted after discussion by experts. And as students could not understand the item of "ability of equalization", it was not an important element and was deleted. In addition, most experts regarded the items of "confidence" and "social contact" in the dimension of "social self-efficacy" as "unimportant", the two items were deleted from the statistical results.

(3) After summarizing the overall degree of agreement of experts, this study confined the results to those with an average above "3.5" (between "Fair" and "Agree"). It was considered that all the experts reached a consensus. Their degree of agreement was above 70%. Among the 14 options in the assessment criteria of the 1st questionnaire, the averages of 4 options were less than 3.5, so they were deleted, as shown in Table 1.

Table 1: Selection of assessment criteria via the 1st round of questionnaire to experts

Target Layer	Primary Criteria	Statistical Results			Secondary Criteria (Assessment Criteria)	Statistical Results			Statistical Results	
		Average	Percentage	Standard Deviation		Average	Percentage	Standard Deviation	Qualified	Disqualified
Key factors improving the self-efficacy of agro-food education	Self-efficacy of diet	3.78	76	0.93	Intake of vegetables	3.89	97	0.78	○	
					Nutrition labeling	2.89	72	0.72	○	
					Dietary habit	4.11	82	0.91	○	
					Dietary behavior	4.22	84	0.70	○	
	Self-efficacy of learning	3.49	70	0.87	Basic abilities	4.0	80	0.69	○	
					Explanation ability	3.22	71	0.88	○	
					Planting ability	3.67	73	0.86	○	
					Conditioning ability	3.33	66	0.97		○
					Ability of equalization	3.22	64	0.92		○
	Social self-efficacy	3.49	70	0.87	Interaction	4.0	80	0.69	○	
					Cooperation	3.22	75	0.88	○	
					Communication	3.67	73	0.86	○	
					Confidence	3.33	66	0.97		○
					Social contact	3.22	64	0.92		○

Source: Compiled by this study.

B. Analysis of the results of the 2nd Delphi Method questionnaire

With respect to the 2nd Delphi Method questionnaire, the averages of 10 assessment criteria were above 3.5. The degree of agreement was above 70%, indicating convergence of expert opinions, as shown in Table 2.

Table 2: Selection of assessment criteria via the 2nd round of questionnaire to experts

Target Layer	Primary Criteria	Statistical Results			Secondary Criteria (Assessment Criteria)	Statistical Results			Statistical Results	
		Average	Percentage	Standard Deviation		Average	Percentage	Standard Deviation	Qualified	Disqualified
	Self-efficacy of diet	4.11	82	0.87	Intake of vegetables	4.00	78	0.97	○	
					Nutrition labeling	2.89	72	0.72	○	
					Dietary habit	4.11	82	0.78	○	
					Dietary behavior	4.22	84	0.97	○	
	Self-efficacy of learning	3.94	79	0.85	Basic abilities	4.22	84	0.83	○	
					Explanation ability	3.67	87	0.73	○	
					Planting ability	3.67	73	0.87	○	
	Social self-efficacy	3.94	79	0.81	Interaction	4.11	82	0.78	○	
					Cooperation	4.00	80	0.87	○	
					Communication	3.78	75	0.83	○	

Source: Compiled by this study.

C. Establishment of indicator hierarchy of key factors improving the self-efficacy of agro-food education

(1) The first layer was the primary criteria.

It included "self-efficacy of diet", "self-efficacy of learning", and "social self-efficacy".

(2) The second layer was the secondary criteria.

The dimension of self-efficacy of diet included four secondary criteria, that is, "intake of vegetables", "nutrition labeling", "dietary habit", and "dietary behavior". The dimension of self-efficacy of learning covered five secondary criteria, that is, "basic abilities", "explanation ability", "planting ability", "conditioning ability", and "ability of equalization". The dimension of social self-efficacy contained five secondary criteria, that is, "interaction", "cooperation", "communication", "confidence", and "social contact".

D. Analysis of the primary criteria

Because the number of primary criteria n = 2, the number of comparison 2(2 - 1)/2 = 1 could be regarded as a convergence effect. Hence, the requirement of consistency was met.

E. Analysis of the secondary criteria

In terms of the analysis of importance of the secondary criteria in the dimension of self-efficacy of diet, "intake of vegetables" has the biggest influence (0.480), followed by "nutrition labeling" (0.263), "dietary behavior" (0.145), and "dietary habit" (0.112) in order.

With respect to the analysis of importance of the secondary criteria in the dimension of self-efficacy of learning, the item of "basic abilities" has the biggest influence (0.493), followed by "explanation ability" (0.277) and "planting ability" (0.230) in order.

For the analysis of social self-efficacy, "interaction" has the biggest influence (0.432), followed by "cooperation" (0.390) and "communication" (0.177) in order.

F. Analysis of weights of pairwise comparisons of matrices of primary (secondary) criteria

After integrating the scores, this study ranked the weights to learn the relative importance among influencing factors. Overall speaking, the assessment factors of two primary criteria and 10 secondary criteria indicated that, intake of vegetables (0.258), basic abilities (0.171), and nutrition labeling (0.142) ranked from the first to the third places in terms of overall weight. The sum of the three criteria accounted for 53.8% of the total weight.

This study classified the three assessment criteria as the influencing factors with [high importance] in the study on key factors improving the self-efficacy of agro-food education. Explanation ability (0.096), planting ability (0.096), and dietary behavior (0.078) ranked from the fourth to the sixth places. The sum of the three criteria accounted for 34.6% of the total weight. This study classified the three assessment criteria as the influencing factors with [moderate importance] in the study on Jhonghe Elementary School. And the experts attached [low importance] to the rest influencing factors, as shown in Table 3.

Table 3: Ranking of the overall weights of primary (secondary) criteria

RANKING OF WEIGHT	COMPREHENSIVE WEIGHT DISTRIBUTION	ASSESSMENT CRITERIA	DIMENSION	IMPORTANCE (PERCENTAGE)
1	0.258	Intake of vegetables	Self-efficacy of diet	53.8%
2	0.171	Basic abilities	Self-efficacy of learning	
3	0.142	Nutrition labeling	Self-efficacy of diet	
4	0.096	Explanation ability	Self-efficacy of learning	34. 6%
5	0.080	Planting ability	Self-efficacy of learning	
6	0.078	Dietary behavior	Self-efficacy of diet	
7	0.060	Dietary habit	Self-efficacy of diet	11.6%
8	0.050	Interaction	Social self-efficacy	
9	0.045	Cooperation	Social self-efficacy	
10	0.021	Communication	Social self-efficacy	

Source: Compiled by this study.

V. CONCLUSIONS

Diet education can obviously help improve one's health, if it starts from a young age. There are three conclusions on the key factors improving the self-efficacy of agro-food education:

(1) Intake of vegetables has the highest weight: It has the first priority to consider.

(2) The weight of basic abilities ranks the second: It is the second important factor.

(3) The weight of nutrition labeling ranks the third: It is the third factor to consider.

Experts regard intake of vegetables as the primary factor. Students can be guided from the three aspects of intake of vegetables, basic abilities, and nutrition labeling and are expected to have the habit of eating vegetables from an early age. Starting from organic diet, children are supposed to develop a healthy and organic dietary habit from childhood to strengthen their physical fitness.

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