

A Study of the Construction of Indicators for “IT-APP” Principals Technology Leadership for Industrial and Vocational High School in Taiwan

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Abstract Objective of principals technology leadership contents, there are 32 topics covering 5 facet being prepared. Following the fuzzy Delphi method, 17 experts were invited to have Delphi rounds questionnaire. The ifacets and breakdowns comprise 26 topics covering 5 facets applied for the confirmation of Principals Technology Leadership indicators “IT-APP” for Industrial and Vocational High School in Taiwan. Based on the determined indicator system, further with analytic hierarchy process (AHP), to determine the priority weigh for each indicator.

Keywords: principals technology leadership, industrial and vocational high school, fuzzy delphi method, analytic hierarchy process (AHP)

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1. Introduction

Senior High School Education Act. Article 5. Senior high schools are classified as follows: Industrial and Vocational High School. This is the origin.

The purpose of using IT in schools, the most important purpose is to improve education. The application of information technology has penetrated the teaching field. Technological leaders must use systematic methods to improve and achieve different levels of leadership requirements (Medcof [1]). The principal’s leadership is crucial to the success of the school and the importance of the impact on the effectiveness of students’ learning, the principal’s leadership can be said to be second only to the teacher’s teaching (Erwin, Winn, & Erwin [2]). Therefore, if the principal can become the technological leader of the school in response to information technology and

effectively improve the school’s performance in running a school, he will be the most competent leader. This research development of “Technological high school principals’ IT-APP model of technological leadership” by Theory-based.

2. Materials and Methods

Bennis & Nanus [3] the manager is the person who does thing right, and the leader is the person who does the right thing.

Wu [4] school administrator that uses organizational human and material resources to achieve school education goals. What makes a leader better than a manager is that he is a pioneer with a vision, it is to create a better future and lead the school towards its visio, not just a manager. Leadership theory and content in various periods shown in Table 1.

Table 1. Leadership theory and content in various periods

Leadership theory (Years)	Content
Trait theory(1900~1940)	Find out the personality traits of the leader that are different from the leader.
Behavior Theory(1940~1960)	Behaviourist School of Psychology, pay attention to the actual leadership behavior of the leader.
Contingency theory (1960~1980)	Whether the leader’s leadership style matches the situation determines successful leadership
Transformation theory (1980~2000)	To strengthen the strengths of individuals and organizations, leaders must build a vision of common development and achieve goals together

Source: compiled by this research.

School is the embryonic form of society, can be said to be a reduced version of society (Yang, Yang, Chen & Shen [5]). The principal is the school leader and the decision maker of important policies. Facing the education environment of information technology, he will face new challenges. Yorulmaz & Can [6] Technology leadership refers to the process of leaders leading school members to learn technology, integrate technology, and use technology in the school environment.

Xu & Lin [7] The principal’s effective use of technology, response to change, and leadership characteristics are closely related to technology leadership.

This research development of indicators for technical leadership of technical high school principals: (1) interpersonal skills (2) Technology Operations and Concepts (3) Assessment and Evaluation (4) Productivity and Professional Practice (5) Procedures, Planning, and Budgeting for Technology Environments.

After the first draft of this questionnaire was completed, it was discussed and revised with the research team to reach a surface validity and compiled an expert validity questionnaire. Six professors were invited to assist in identifying the suitability of the questionnaire and 15 people filled in the questionnaire.

3. Proposed Model

3.1. Fuzzy Delphi Method

Equation (1), Triangular fuzzy number

$$\tilde{W}_{ik} = (a_{ik}, b_{ik}, c_{ik}), i = 1, 2, 3, \dots, n$$

$$a_k = \min_i \{a_{ik}\}, b_k = \frac{1}{n} \sum_{n=1}^n b_{ik}, c_k = \min_i \{c_{ik}\}$$
(1)

where, \tilde{W}_{ik} =Triangular fuzzy number, (a,b,c)=Initial value filled by experts. a=Minimum acceptable value (Min), b=Maximum acceptable value (Max), c=Best single value.

3.2. Screening Evaluation Indicators

Equation (2), Defuzzification by Simple Center of Gravity:

$$S_k = \frac{a_k + b_k + c_k}{3}, j = 1, 2, 3, \dots, n$$
(2)

Equation (3), This study is based on the usual threshold ($\alpha = 0.7$), if defuzzified number $S_k \geq \alpha$, accept, if $S_k < \alpha$, delete the factor.

3.3. Analytic Hierarchy Process (AHP)

- a. Build a hierarchical structure.
 - b. Design scale: establish paired comparison matrix.
 - c. Establish fuzzy positive reciprocal matrix: Calculate eigenvalues and eigenvectors (Formula: $AW = \lambda W$)
- Equation (3)

$$W_i = \sqrt[m]{\prod_{j=1}^m a_{ij}} / \sum_{i=1}^m \sqrt[m]{\prod_{j=1}^m a_{ij}}$$
(3)

Where, m=Number of decision criteria.

- d. Consistency: Concordance ratio (C.R.<0.1).
 - e. Calculate fuzzy weight.
 - f. Defuzzify: Application of this research is center of gravity method (DF)
- Equation (4)

$$DF = \frac{(M_i - L_i) + (U_i - L_i)}{3} + L_i, \forall i$$
(4)

3.4. Reliability and Validity

The α of the Fuzzy Virtues Surgery Scale is “Expert consensus value G_i ” General customary threshold $\alpha = 7.0$. Consistency index CI. The two-stage scale of this study includes the fuzzy morality technique and the fuzzy level analysis scale by experts suggest to be modified and tested possess expert validity.

4. Results

4.1. Fuzzy Delphi

According to the expert evaluation values obtained from the questionnaire, follow the steps to establish the triangular fuzzy function of each selection criterion.

- a. Most optimistic cognitive triangular Fuzzy Number $A_i = (L_i, M_i, U_i)_{L-R}$. Most conservative cognitive triangular Fuzzy Number $a_i = (l_i, m_i, u_i)_{L-R}$.

- b. “Expert consensus value G_i ”

$$G_i = \frac{(L_i + u_i)}{2}$$
(5)

$G_i \geq \alpha$, accept, if $G_i < \alpha$, delete the factor.

“Technical Leadership IT-APP Indicators for Technical High School Principals” Relative weight shown in Table 2.

Table 2, Technical Leadership IT-APP Indicators for Technical High School Principals”Ordering of facet weight values

Target layer	Facet layer (weight values)	Ordering of facet weight values	Index layer code	Relative weight value of overall index	Importance ranking
“Technical Leadership IT-APP Indicators for Technical High School Principals” ndicator system	A. interpersonal skills (0.165)	3	A1	0.036	16
			A2	0.060	1
			A3	0.037	15
			A4	0.049	8
			A5	0.047	10
	B. Technology Operations and Concepts (0.174)	2	B1	0.048	9
			B2	0.045	11
			B3	0.041	13
			B4	0.051	6
			B5	0.044	12

Target layer	Facet layer (weight values)	Ordering of facet weight values	Index layer code	Relative weight value of overall index	Importance ranking
"Technical Leadership IT-APP Indicators for Technical High School Principals" indicator system	C. Assessment and Evaluation (0.178)	1	C1	0.044	12
			C2	0.050	7
			C3	0.055	4
			C4	0.056	3
			C5	0.057	2
	D. Productivity and Professional Practice (0.162)	4	D1	0.041	13
			D2	0.037	15
			D3	0.051	6
			D4	0.044	12
			D5	0.036	16
			D6	0.044	12
	E. Procedures, Planning, and Budgeting for Technology Environments (0.149)	5	E1	0.027	18
			E2	0.049	8
			E3	0.035	17
			E4	0.054	5
E5			0.038	14	

5. Discussion

"Technical Leadership IT-APP Indicators for Technical High School Principals" Analysis of relative weight survey results.

a. "interpersonal skills" facet have 5 breakdown index. A-2 "The principal can respect the different opinions of others" relative weight highest is 0.060. A-1 "The principal knows that the success of the school is not entirely attributable to the principal" Relative weight is 0.036. The indicator of the highest relative weight value of this facet "Respect the different opinions of others". Schut [8] account "the theory of interpersonal needs" think that the harmony of human relationships between people comes from the affection, inclusion, control. The most important thing for a successful school leader is to accept the opinions of others, respect and understand, care about people, and solve problems.

b. "Technology Operations and Concepts" facet have 5 breakdown index. B-4 "The principal can handle teacher training based on the newly purchased equipment in the school" relative weight highest is 0.051. B-3" Principals can explain to school teachers their determination to promote IT education in schools" relative weight lowest is 0.041. Schools need to be able to provide more teacher study platforms and practical experience (Yang, Yang, Chen & Shen [5]). Let teachers face the new technology handily, integrate into teaching, and improve teaching effectiveness. It is the same as the conclusion of the indicator with the highest relative weight value in this dimension, "Teacher training based on the newly purchased equipment in the school".

c. "Assessment and Evaluation" facet have 5 breakdown index. C-5 "Principals can pay attention to the teaching or research results of IT education and evaluate teachers' use of technology" relative weight highest is 0.057. C-1" The principal encourages teachers to use technology and information technology to make multiple assessments of students' learning outcomes" relative weight lowest is 0.044. The principal guides school members to develop professional development plans related to the use of personal information technology, Can promote teacher introspection and teaching performance or administrative efficiency (Lu, Huang & Wu [9]). If the top instructor of the school can encourage members to further their education in IT, and apply it to the school, it will effectively enhance the school's effectiveness. It is the

same as the conclusion of the indicator with the highest relative weight value in this dimension, "Pay attention to the teaching or research results of IT education".

d. "Productivity and Professional Practice" facet have 6 breakdown index. D-3 "The principal will undertake IT related projects of the Ministry of Education to enhance the IT literacy of school members" relative weight highest is 0.051. D-5" T Principals will ask teachers of all subjects to make good use of information technology to enhance students' interest in learning and learning effectiveness" relative weight lowest is 0.036. The indicator of the highest relative weight value of this facet "The principal will undertake IT related projects of the Ministry of Education to enhance the IT literacy of school members" Principals must carry out scientific and technological leadership, that is, they must be able to lead the school to undertake and implement relevant IT plans of the Ministry of Education. This conclusion is the same as the following scholars. Wen [10] principal support teachers' curriculum and teaching and teachers to work together to actively participate in competitive projects to obtain subsidies to improve the school's software and hardware equipment.

e. "Procedures, Planning, and Budgeting for Technology Environments" facet have 5 breakdown index. E-3 "Principals can fairly allocate learning resources for IT equipment and technical and vocational education." relative weight highest is 0.054. E-5"The principal will propose a plan in the Ministry of Education's high-quality plan to upgrade the school's IT equipment." relative weight lowest is 0.027. In 2015 at United Nations sustainable development summit statement 2030 Agenda for Sustainable Development to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. Shi & Shi [11]. The study found that the principal supports the construction of technology facilities, assists in administrative and teaching work, and ensures that school members and students can use technology facilities equally. It is the same as the conclusion of the indicator with the highest relative weight value in this dimension, "Principals can fairly distribute IT equipment and technical education resources".

6. Conclusion

This research has undergone literature analysis and completed the first draft of 5 levels and 32 indicators,

17 experts and scholars formed a Delphi expert group to conduct a questionnaire survey on fuzzy Delphi method, expert consensus value Gi indicator for consistency reliability analysis, reduced to 26 topics. Expert consensus values of all indicators Gi indicators are greater than 8.0. "IT-APP" Principals Technology Leadership for Industrial and Vocational High School, get high consistency. Analytic hierarchy process (AHP), to determine the priority weigh for each indicator. It can be used as a reference basis for the principal to implement scientific and technological leadership. "IT-APP" Principals Technology Leadership for Industrial and Vocational High School. Comprises 5 layers: "interpersonal skills", "Technology Operations and Concepts", "Assessment and Evaluation", "Productivity and Professional Practice" and "Procedures, Planning, and Budgeting for Technology Environments". For technical high school principals to carry out technological leadership, they must first communicate fully with their subordinates and solicit opinions from others, In-school study for new equipment to enable teachers to use technology to improve teaching effectiveness.

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