Validation of school organisational innovation assessment indicators for universities and institutes of technology

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ABSTRACT: This study aimed to verify the dimensions and assessment indicators proposed by the research team for measuring the organisational innovation of universities and institutes of technology in an earlier study. The research sample was based on the eight top-ranked public schools and the ten top-ranked private schools in the 2007 Intelligence Output and Application Efficacy, and another 18 randomly-selected schools. R&D directors of these schools were asked to evaluate their schools' organisational innovation. In total, 36 questionnaires were distributed and 20 valid questionnaires were returned. After collecting the data, weighting estimation was undertaken using the Mann-Whitney U test and discriminant analysis. Research results revealed that the dimension, indicators and weighting proposed by the former research were appropriate for measuring the organisational innovation of schools. The classification of discriminant analysis had 85% of predictability, indicating that current assessment indicators could be used to evaluate the innovative status of university of technology and institute of technology.

INTRODUCTION

According to the Department of Statistics, Ministry of Education, there were five universities of science and technology and fifteen institutes of technology up to 1997. Under the guidance of Taiwan's Ministry of Education, institutes of technology and junior colleges alike strive to elevate themselves to a higher status, causing the numbers of universities and institutes of technology to swell to 41 and 37, respectively. However, due to the current trend of a lower birth rate, the number in the school age population has been shrinking dramatically. Compounded by recruiting policies of foreign and Chinese schools, Taiwan's advanced education market is now in an oversupply situation, which poses a threat to the schools' survival [1]. As a result, standing out of the crowd among the copious number of schools has been a crucial task for universities and institutes of technology.

Huang suggested that schools should encourage innovation in teaching, administration and learning in order to survive through sustainable management [2]. As a result, education personnel must exhibit *creativity* and *mobility* to pursue the goal of innovation and to benefit students. The role of the school is to provide students with new incentives and motivation and to cultivate new values in them. To run a school under the goal of organisational innovation, teachers could improve students' learning efficacy, and students could also learn skills and harbour creative energy. For both schools and students, to manage a school in innovative ways would contrast the distinctiveness of a school from others. The operation of schools includes strategy, teaching, research and administrative support [3]. Organisational innovation ability is an important indicator influencing its performance [1][3][4]. If a school wishes to promote innovation activities, the key to its success is its innovation ability. The purpose of organisational innovation is to improve school performance and to develop the special features of a school.

In 2005, Taiwan's Ministry of Education launched a series of assessments of universities and institutes of technology. Indicators involved both administration and professional assessment. Administration assessment indicators were subdivided into comprehensive institutional administration, academic affairs administration, student affairs administration and administrative support. Professional assessment indicators included six college and seven department assessment items. College indicators were: organisation and development, curriculum planning and integration, mechanisms for integrating qualified teachers, teaching quality, facility integration, cooperation between the industry and the academic, and research collaboration. Department indicators were: the development of departmental affairs, curriculum planning, structure and qualification of faculty, facilities and library resources, teaching quality, student achievement and development, and research and technology development [5]. However, these assessment indicators were more concerned with institutional administration [4]. With respect to teaching efficacy and the development of students, indicators encompass achievements of research innovation in the dimension of research and technology development. Other indicators lack the perspective of organisational reformation and, hence, current indicators could not reflect a school's achievement in this respect. Whether or not schools' organisation reformation

could be evaluated by the current assessment indicators so that schools could improve themselves based on the evaluation results is the research purpose of study.

The former study conducted expert focus groups twice and concluded that organisational innovation must cover seven dimensions and 25 indicators, including leadership innovation, administration innovation, student affairs innovation, curriculum and instruction innovation, the teachers' professional development innovation, resource application innovation and campus innovation. Using Analytic Hierarchy Process (AHP) to calculate the relative weighting of each dimension and indicator, the study confirmed that these organisational innovation indicators could reflect the current status of universities and institutes of technology well [1].

LITERATURE REVIEW

Organisational Innovation

Previous studies have indicated that organisational innovation directly influences schools' innovation management efficacy. Chang and Wu defined organisational innovation as schools' various business management of school administration, teaching and service promotion framed within external environmental changes and internal operation by way of innovative thinking, approaches and strategies [6]. Yan and Chang suggested that innovative management refers to the improvement of educational performance and the construction of an organisational culture that invites members to participate in innovative activities. By managing and operating the knowledge system, the systematic business strategy facilitates creativity, as well as the sustainable management [7].

Researchers' perspectives differ in essential components of organisational innovation. For example, Daft and Becker divided school organisational innovation into two categories - education innovation and administrative innovation [8]. Chin and Pu classified organisational innovation into administration management innovation, curriculum and educational innovation, external relation innovation, study activity innovation and campus environment innovation [9]. Wu suggested that innovative management includes conceptual innovation, technological innovation, product innovation, service innovation, process innovation, activity innovation, environmental innovation, and featured innovation [10]. Lee proposed four dimensions of innovation for school organisation, which are teaching behaviours, facility innovation, organisational atmosphere innovation and administration innovation [11]. In other words, schools provide new teaching facilities and new administrative strategies to encourage innovation, which in turn facilitate innovation in teaching and organisation. Teachers make use of teaching devices and teach students in innovative ways, which improves school efficacy. Hsiao et al suggested that organisational innovation included leadership innovation, administration innovation, student affairs innovation, curriculum and instruction innovation, the teachers' professional development innovation, resource application innovation and campus innovation [1].

Indicators of Education Assessment

Education assessment is the most fundamental component of the evaluation process. The content, standard, and ways of statement all affect the impartiality and objectivity of evaluation. Chang proposed a series of processes to construct education indicators such as empirical data collection and organisation, the design of education indicators, integrating conceptual indicators, and converting empirical data [12]. Hsiao argued that educational assessment is a kind of formal and systematic judgment. By way of data collection and analysis, making judgments on educational institutions and proposing recommendations to decision makers is a continuous process [13].

The evaluation system of Taiwan's universities and institutes technology is based on the Context, Input, Process and Product (CIPP) assessment model proposed by Stufflebeam et al [14], which includes Context, Input, Process and Product. In the so-called CIPP model, context assessment is to facilitate the selection of targets. As a result, CIPP is also known as environmental assessment or needs-based assessment. Input assessment is used to correct educational plans, which is also termed resource assessment. Input assessment is a kind of directory action principle, which aims to search for possible pathways to monitor the plan. Process evaluation is employed to guide the implementation of education programs, which intends to assess education plans and programs in process. Product evaluation is utilised to provide reference points for verifiable decisions. After implementing the evaluation plan, these evaluation dimensions can be used to measure the efficacy of the plan or program. Decision makers will decide if the plan should be continued, terminated or transformed.

Popham indicated that there are three commonly used types of education evaluation model: an objective-based evaluation model, such as *Tyler's objective-based evaluation*; a decision-making context evaluation model, such as *Stufflebeam's decision-making activation evaluation*; and an external validation criterion evaluation model, such as *Scriven's customer-directed evaluation* and *Stake's client-centred evaluation* [15].

Chen analysed 187 theses of educational evaluation produced over the last thirty years. Among them, 29 were concerned with school evaluation (15.5%, ranked second), 19 were about academic affairs evaluation (8.6%, ranked fourth) and 11 were about facility evaluation (5.9%, ranked seventh). Most of the research on school evaluation focused on the status of school development and discussed the issue from an overall quality perspective, while studies on academic affairs evaluation reflected the practical dimension of school administration [16].

Lin constructed a set of Taiwan-based college performance evaluation indicators, including six internal evaluation dimensions, which are student quality, teacher resource, financial resource, teaching resources, student structure, and development objective and features. Process evaluation dimension included six items: teaching quality, research, administration, curriculum, guidance and retention rate. External evaluation dimensions include six items, namely: school reputation, fund donation, academic exchange, education service promotion, employment status of college graduates, and responsibility of civil society and citizens' obligation [17].

The previous study conducted by the research team constructed the assessment indicators based on seven dimensions, respectively leadership innovation, administration innovation, student affairs innovation, curriculum and instruction innovation, the teachers' professional development innovation, resource application innovation and campus innovation [1].

METHOD

In addition to the seven dimensions, 25 indicators and weighting proposed by Hsiao et al [1], this study further validated the relative weighting of theses dimensions and indicators. The subjects were universities and institutes of technology: the eight top-ranked public schools and the ten top-ranked private schools in the 2007 Intellectual Output and Application Efficacy complied by Chen and Keng [18]. In addition, another 18 schools were randomly selected as research subjects. The R&D directors of these 36 schools were asked to conduct a self-assessment of organisational innovation.

The questionnaire contained seven dimensions and 25 items (each item with two to six indicators). Each R&D director responded according to a scale from one to five, where 1 was non-implemented item; 2 was partial implementation without written documentation; 3 was implemented item without written documentation; 4 referred to implemented items that were spoken, activated and written in schools with formal documentation; and 5 referred to implemented items that are spoken, activated and written in schools with good efficacy.

In total, this study distributed 36 questionnaires and retrieved 26 responses. After eliminating invalid questionnaires, the study obtained 20 effective questionnaires. Weighting analysis was conducted on the data. For example: if a R&D director evaluated the vision, academic affairs development, participatory decision-making and respectively rated them as 4, 4, 3, the score of the leadership innovation would be 4*0.3917*20+4*0.2887*20+3*0.3197*20=73.614. After weighting analysis, the new score of leadership innovation would be 73.614*0.2673=19.677. The study repeated the process several times, and demonstrated that the score of items varied from 56.1 to 97.7, as shown in Appendix 1.

RESULTS

Results of Mann-Whitney U test are presented in Table 1. Except for teacher professional development, schools with higher intellectual output performance and application efficacy scored higher than their lower counterparts, indicating that the assessment process developed by the present study can appropriately reflect the organisational innovation of universities of technology and institutes of technology.

Table 1: Mann-Whitney U test between high and low performance.

Dimension	Performance	N	Ave. of Rank	Sum of Rank	Z-value	p
Leadership	High	10	14.5	145	3.046	0.002**
	Low	10	6.5	65		
Administration	High	10	13.5	135	2.282	0.023*
	Low	10	7.5	75		
Student Affairs	High	10	13.8	138	2.502	0.012*
	Low	10	7.2	72		
Curriculum and Instruction	High	10	13.65	136.5	2.387	0.017*
	Low	10	7.35	73.5		
Teachers' Professional Development	High	10	12.85	128.5	1.777	0.076
	Low	10	8.15	81.5		
Resource Application	High	10	14.45	144.5	2.993	0.003**
	Low	10	6.55	65.5		
Campus	High	10	13.45	134.5	2.274	0.023*
	Low	10	7.55	75.5		
Total	High	10	14.5	145	3.024	0.002**
	Low	10	6.5	65		

Table 2 distinguishes between universities of technology and institutes of technology. It indicates that the former scores higher than the latter in organisational innovation. There are significant differences between these two types of school in items relating to student affairs, curriculum and instruction, resource application and campus innovation, suggesting that universities of technology achieve better than institutes of technology.

Table 2: Mann-Whitney U test between university of technology and institute of technology.

Dimension	Type	N	Ave. of Rank	Sum of Rank	Z-value	p
Leadership	University	11	12.64	139	1.798	0.08
	Institute	9	7.89	71		
Administration	University	11	12.05	132.5	1.299	0.201
	Institute	9	8.61	77.5		
Student Affairs	University	11	12.95	142.5	2.057	0.038*
	Institute	9	7.50	67.5		
Curriculum and Instruction	University	11	13.23	145.5	2.285	0.020*
	Institute	9	7.17	64.5		
Teachers' Professional Development	University	11	12.32	135.5	1.520	0.131
	Institute	9	8.28	74.5		
Resource Application	University	11	13.59	149.5	2.589	0.007*
	Institute	9	6.72	60.5		
Campus	University	11	13.50	148.5	2.557	0.010*
	Institute	9	6.83	61.5		
Total	University	11	13.45	148	2.469	0.012*
	Institute	9	6.89	62		

Table 3: Mann-Whitney U test between public and private schools.

Dimension	Attribute	N	Ave. of Rank	Sum of Rank	Z-value	p
Leadership	Public	5	13.90	69.5	1.495	0.135
	Private	15	9.37	140.5		
Administration	Public	5	10.90	54.5	0.176	0.861
	Private	15	10.37	155.5		
Student Affairs	Public	5	12.50	62.5	0.876	0.381
	Private	15	9.83	147.5		
Curriculum and Instruction	Public	5	12.10	60.5	0.700	0.484
	Private	15	9.97	149.5		
Teachers' Professional Development	Public	5	12.10	60.5	0.699	0.485
	Private	15	9.97	149.5		
Resource Application	Public	5	13.40	67.0	1.269	0.205
	Private	15	9.53	143.0		
Campus	Public	5	13.40	67.0	1.291	0.197
	Private	15	9.53	143.0		
Total	Public	5	13.40	67.0	1.266	0.206
	Private	15	9.53	143.0		

Table 3 suggests that the differences between public and private schools are not significant in each dimension after being tested according to the Mann-Whitney U test. However, Chin and Pu have argued that public schools have less pressure in recruiting students than private schools and have a slower pace in innovation [9].

Results shown in Table 3 reveal that the attributes of schools are not sufficient to determine their organisational innovation. Other factors, such as organisational culture and organisational learning should be further investigated.

Table 4: Summary of discriminant function analysis.

Dimension	Discriminant Fuction		Average	
	Coefficient of Discriminant Fuction	Coefficient of Discriminant Loading	High Performance	Low Performance
Leadership	0.744	0.763 ++	88.009	63.202
Administration	-0.426	0.562 ++	82.260	66.471
Student Affairs	0.042	0.685 ++	83.877	60.679
Curriculum and Instruction	1.495	0.614 ++	83.707	68.768
Teachers' Professional Development	-1.135	0.384 +	84.659	73.714
Resource Application	0.700	0.751 ++	87.354	68.744
Campus	-.697	0.521 ++	74.773	59.682

+ Coefficient of discriminant loading > 0.3 (had discriminant ability)

++ Coefficient of discriminant loading > 0.45 (had strongly discriminant ability)

Table 5: Classification of discriminant function analysis [a].

		Performance	Predictability		Sum
			High Performance	Low Performance	
Original	N	High Performance	9	1	10
		Low Performance	2	8	10
	%	High Performance	90.0	10.0	100.0
		Low Performance	20.0	80.0	100.0

a) 85.0% original observation was proper classification

Results of discriminant function analysis are presented in Table 4. Discriminant loading of each dimension has discriminant ability, whose coefficient is above 0.3. Except for teacher professional development, other dimensions have *strong discriminant ability*, whose coefficient is above 0.45. These results suggest that the organisational innovation assessment table could successfully distinguish schools with high efficacy from those with low efficacy. Table 5 presents the results of classification, which has 85% predictability.

DISCUSSION AND CONCLUSIONS

According to the statistical analysis, this study suggests that the dimension, items and weighting of organisational innovation proposed by the research team's earlier research could reflect the organisational innovation status of universities and institutes of technology. Results of the classification have 85% predictability, suggesting that the assessment form could be used to evaluate the organisational innovation status of universities and institutes of technology correctly.

Results indicate that universities of technology score higher than institutes of technology in organisational innovation. Therefore, this study suggests that Taiwan's Ministry of Education should evaluate institutes of technology on the basis of school organisational innovation indicators before granting them university of technology status. Thus, it could prevent institutes of technology from stagnating at their current level of educational quality.

Since there are no significant differences between public and private schools in organisational innovation, future studies could take into consideration other factors, such as organisational culture and organisational learning.

One of the limitations of the present study is that it incorporates only the perspectives of R&D directors discussing the issue of organisational innovation. Future studies could include perspectives of other school administrators, and compare them with the results obtained from the present study. In addition, external personnel should be grouped into assessment groups and they should adopt observation, document review, and in depth interview to evaluate school organisational innovation.

Currently, there are diverse ways of obtaining organisational innovation, and this study suggests that scholars could probe to the factor of innovative atmosphere and compare it with the results of the present study in order to reach a broader understanding of organisational innovation.

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Appendix 1: After AHP weight calculated.

School	Dimension Weight performance	Leadership 26.73%	Administration 8.85%	Student Affairs 7.62%	Curriculum and Instruction 19.40%	Teachers' Professional Development 18.35%	Resource Application 11.90%	Campus 7.15%	Total
A	High	23.47	7.08	6.61	16.24	16.81	11.90	5.72	87.8
B	High	26.73	8.56	6.57	16.24	17.73	11.90	4.84	92.6
C	High	26.73	6.61	7.09	16.08	17.38	10.46	5.72	90.1
D	High	19.30	6.38	6.61	17.29	12.90	9.23	7.15	78.8
E	High	21.38	7.08	7.09	15.52	15.30	9.72	4.29	80.4
F	High	26.73	8.38	7.11	19.40	18.35	11.90	5.72	97.6
G	High	21.38	6.38	5.04	13.29	11.63	10.84	4.84	73.4
H	High	23.09	7.08	6.57	15.52	14.06	10.02	5.72	82.1
I	High	19.67	7.57	4.59	16.24	15.36	7.87	4.29	75.6
J	High	26.73	7.68	6.64	16.57	15.84	10.12	5.17	88.7
K	Low	19.83	6.01	3.56	11.64	10.77	6.94	3.74	62.5
L	Low	19.67	6.38	5.04	13.56	13.08	9.09	5.17	72.0
M	Low	21.38	7.09	6.10	14.32	12.90	9.09	4.84	75.7
N	Low	7.43	3.25	2.58	14.65	15.80	8.16	4.29	56.1
O	Low	16.20	7.39	3.56	12.49	13.71	6.51	2.86	62.7
P	Low	16.04	5.31	4.57	12.36	13.14	7.87	4.29	63.6
U	Low	19.67	5.31	5.04	12.36	12.55	7.77	4.29	67.0
R	Low	19.83	7.39	5.11	16.37	16.75	9.39	4.29	79.1
S	Low	18.12	6.38	7.15	17.29	17.10	10.41	6.04	82.5
T	Low	10.69	4.32	3.52	8.36	9.47	6.58	2.86	45.8