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Enhancing E-learning Management Systems to Promoting the Management Efficiency of Tourism and Hospitality Education

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ABSTRACT This research is a performance evaluation exploring teaching quality improvement strategies in tourism and hospitality (TH) education and its impact on operational performance. First, by using Data Envelopment Analysis (DEA) in the Assurance Region Model (AR), the relative managerial efficiency of tourism and hospitality departments in 57 higher education institutes in Taiwan were analyzed. Using the AR model, in-depth interviews and meetings with experts were conducted to obtain qualitative data. Practical educational management of both educational investments and output were taken into account, and appropriate evaluation indicators and weighting were established to increase differentiation and item discrimination indices of the data. Results of the research enabled a more precise measurement for analyzing the effectiveness of tourism and hospitality education management models. Furthermore, results of Mann-Whitney test showed that schools with e-platform, mechanisms for strategic alliance (such as overseas practicum and dual degree programs) manifested more outstanding performance in output efficiency. However, operational performance was not contingent on whether the school was public or private while school location and types of courses showed significant impact. A set of method for evaluating education performance was proposed. Analysis of the operational efficiency and scale efficiency of resource utilization by various TH education departments provided practical help for schools and educational decision-makers to understand the competitive realities of the TH education world and help schools with improvement strategies.

INTRODUCTION

Pursuit of excellence and increasing educational quality are current developmental goals among higher education all over the world. In response to the changing nature of tourism industry worldwide, TH departments in our country are increasing rapidly, and institutes of higher education are facing an increasingly competitive environment. School departments are also facing the question of how to use educational resources. In addition, improving the output quality of higher educational institutes and operational efficiency have also become important issues.

The primary goal of TH education is to cultivate students who have a wealth of professional TH knowledge, excellent service skills and correct service attitude. Moreover, they must be able to apply their learning to the field, and become professionals that the tourism industry can rely on. The three important goals for competitive TH education are practical human resource development (HRD) for TH industries, improving the technical research and development (R and D) of various industry-universities and strengthening innovative managements of diverse cultural knowledge (Chang and Hsu 2010).

With increasing technology and use of the internet, modern consumer behaviors have changed. Therefore, industries must change or update their facilities with new technology; Taiwan's Ministry of Education has been investing a great amount of resources to improve teaching quality in order to meet current vocational training needs of the industry, as exemplified by the Teaching Excellence Plan proposed in 2005. Through investing in educational resources such as courses and teaching staff, schools became regulated and the sustainability of instruction was improved to enhance the quality of learning (Ministry of Education Taiwan 2008). Of these, important strategies to better teaching quality included introducing technology into teaching and guidance, such as establishing channels for e-teaching, constructing student e-portfolio, and encouraging teachers to develop e-teaching materials and implement e-teaching. In addition, methods such as cultivating professional licensing for students, cooperative mechanism between industries and universities, field practi-

cum plan and participation in international TH competitions can enhance the field application of skills for students of TH departments. To boost competitiveness, schools should incorporate new ideas and styles into their new operational strategies, and attend to various performance outputs. As such, there is a critical need for valid and accurate evaluation and management of efficient resource utilization. Besides helping management understand the resource utilization efficiency of various TH departments, performance evaluation can identify the benchmark factors benchmark departments and improvement directions. Optimal utilization of limited resources and excellent output can help schools become more competitive in acquiring resources and sustaining development.

There are three major strategies that schools use to enhance teaching quality. The first method involves introducing e-channels for learning and integrating courses, teaching materials, student learning and teaching guidance in order to increase teaching and learning efficiency. Another way is developing the advantages of strategic alliances and optimizing international academic cooperation such as by signing dual degree programs with sister schools abroad, signing overseas practicum contract and establishing exchange teacher programs. The last method is strengthening the cooperation between industries and universities by cooperating in research and development and providing students with practicum opportunities in tourism industries, increasing patents and transferring of technological functions to boost international competitiveness of the tourism industry.

In their quest for competitiveness in TH education, different schools are confronted with unique environmental features and resource distribution. Therefore, is enhancing the educational quality improvement strategies of each school an effective mean? When drafting strategies, the relative operational performance of each school's TH education must first be understood, such as knowing what factors influenced the operational performance of education and which schools are worth learning from. A self-evaluation of strength and weakness can then be made and a competitive strategy formed. Therefore, this paper explored the following two issues:

1. How is the current operational performance of TH education? Is operational performance influenced by differences such as public or private ownership, location and course characteristics?
2. What are the important elements of the quality improvement strategies for TH education? What are the operational performances for different strategies?

To answer the aforementioned questions, factors defining input-outcome assessment for TH education operational performance must first be defined before evaluating the operational performance of each department. Subsequently, the differences in efficiency among the departments were examined. Different departmental characteristics were than summarized according to educational resource allocation and strategy direction for improving teaching.

LITERATURE REVIEW AND RESEARCH HYPOTHESE

TH Vocational Education System

Higher vocational education and economic development are closely intertwined. Since 1960, many scholars (Schultz 1961; Becker 1975) have emphasized human capital in higher vocational education and its critical role in economic development. The concept of human capital has made personnel training the key to the survival for corporations, and has also become a major goal in a nation's strive for competitiveness. To create a competitive educational system, the needs and expectations of its critical players (students, teachers, corporations, government, etc.) must first be understood. Etzkowitz (2005) proposed a triple helix, which is a new interactive system comprising colleges, industries and government. From the perspective of education economics, the importance of the return on educational investment to the competitiveness of countries and corporations can be understood. This study examined the interactive cycle proposed by Etzkowitz (2005) from the standpoint of resource investment. Personnel training for TH industries occur mainly through educational investment by schools, and the value of employees is translated into corporate profits, which is effective for boosting industrial competitiveness. At the same time, corporations reciprocate by reinvesting resources back into schools and government as educational resources, thereby sustaining the basic competitive components of the country and corporation. This also manifests the

mechanism of cooperation between industry and school, which is central to vocational education. Based on this interactive system, this study used in-depth interviews and focus group qualitative process, and accounting for the impact of environment and quality, examined the operational performance of TH education investment and output factors and weighting in order to validly measure operational efficiency.

TH Education Evaluation Indicators and Measurement Method

Review of educational theories shows that indicators were mainly selected based on the educational function of teaching, research and service provision. Invariably, the better the educational output, the more elements were invested, and for other institutes, it becomes comparatively easy for evaluation to result in many ineffective investments. In the past, performance evaluation of universities and colleges were mostly based on fulfilling Ministry of Education evaluation. Performance indicators included student-teacher ratio, teaching hours, student certification, student counseling, library and equipment facilities, course design, teachers' research achievements, teaching plan and teachers' participation in academic seminars.

Nevertheless, educational evaluation can only meet the minimal requirement of competition. Each school must achieve its competitive edge in order to find favor with corporations and students among the many competitors. Therefore, current performance evaluation should focus on the optimal utilization of limited resources. In addition to the achieving basic evaluation threshold, schools must consider improving their performances in other indicators to boost their overall competitiveness (Kao 2009).

In terms of investment indicators, past research on the performance of educational organizations have adopted many indicators of resource investments, such as the number of teachers (Fernando and Cabanda 2007; Tyagi et al. 2009), routine operational cost of departments (Martin 2006; Kao and Hung 2008; Tyagi et al. 2009) facilities (Martin 2006; Castano and Cabanda 2007) and floor area (Leitner et al. 2007; Kao and Hung 2008). Generally, investment indicators were based on the economic perspective of resource investment, including manpower, financial and material investment. Therefore, educational investment can include factors such as professional teachers, facilities and equipment, and routine (daily) operational cost.

In terms of educational output indicators, the goals of vocational education should value both teaching and academic research and development, develop theories and practices that are useful to industries, especially in areas of human resource. Therefore, selected indicators should include both teaching and research and development outputs since student field performance could reflect the school's educational performance, and "employer satisfaction" could objectively reflect the TH educational output of schools. Furthermore, strengthening cooperation between industry and academics could create a rich and flexible learning environment, thereby cultivating students with international vision and professional ability (Jayawardena 2001). Also, industry-university programs were frequently used to evaluate the research output efficiency of educational units (Leitner et al. 2007; Kao and Hung 2008). The stronger the cooperative relationship between an institute and industries, the more marketable the skills of that particular educational institution, and probably the better its reputation (Kao and Hung 2008).

Given the aforementioned factors, and based on accurate and complete information and interviews with experts, the investment indicators selected for this study were: the number of full-time teachers(X1), amount of money invested into facilities and equipment (including specialized classrooms and e-learning platforms) (X2), and annual routine operating expenses

(X3). Output indicators were: employer satisfaction (Y1), research and development achievements (Y2) and income from industry-university cooperation (Y3). Information sources were the Ministry of Education Basic Database of Higher Technological and Vocational Education and the Statistical Overview of Universities in the Republic of China. Details are as follow:

(1) Input Factor

1. Number of Full-time Teachers(X1): Student development is contingent on the transmission of professional knowledge and skills by teachers, and hence the number of teachers is a school's most valuable resource. Using Kao's (2009) equivalence of one employee to 0.5 teach-

er, this research used the number of departmental full-time teachers and staff to evaluate the department's educational investment.

2. Amount of Money Invested into Facilities and Equipment (X2): including departmental investment into specialized classrooms and channels for e-learning, and student portfolios.

3. Annual Routine Operating Expenses (X3): Departmental development is contingent on continual investments, and the budget for annual routine operating expenses is reflective of resources available for establishing a professional learning and teaching environment and strengthening teaching and learning effectiveness. This research used the amount invested into routine operating expense as investment indicator of educational and administrative resources.

(2) Output Factor

1.Employer Satisfaction (Y1): Tourism graduates must be employable, and as such, the quality of student performance must be assessed from the perspective of corporations. Therefore, this research used employer satisfaction toward the graduates to evaluate the performance quality of a department's students.

2. Departmental Research and Development (Y2): Research output was evaluated according to the number of thesis published in journals by full-time teachers. This is one way to assess the research performance of teachers. However, review standards differ according to journals, and based on the research standards adopted by scholars and relevant standards for school rankings, and only those who were published according to SCI, SSCI, TSSCI and EI standards were counted.

3. Income from Industry-university Cooperation (Y3): Included income from National Science Council projects, industry-university programs, cooperative education and patents. These were also important indicators of teachers performance, and besides increasing school income, they also increased the research ability and experience of teachers as a result of cooperation with corporations. Moreover, they also increased practicum and employment opportunities for students.

Performance Evaluation Model

Performance evaluation is necessary to management. It is not only a basis for management decisions, but can also be a reference for establishing and evaluating work plans. Therefore measuring management performance has always been an important and enduring issue. In the literature, discussions on methods of performance evaluations mostly focused on measuring efficiency. Since Charnes, Coopera and Rhodes (CCR) forwarded the Data Envelopment Analysis (DEA) in 1978, it has been embraced as an effective way to measure the relative efficiency of numerous organizational inputs and outputs. Literature review has also shown that DEA is commonly applied to research in efficiency measurement of educational organizations. To evaluate the overall operational efficiency of universities or vocational institutes, many scholars have used different evaluation methods and applications to allow for varying perspectives among different countries, object of assessment and assessment goals (Ahn et al. 1998).

The DEA was first developed for the purpose of evaluating the performance of non-profit organizations, but became extensively applied to production industries and public organizations. It is not only used to evaluate the relative efficiency of private companies but can also be used to evaluate the relative efficiency of a company's branch (such as a branch bank, fast food chains and superstore chains, etc.), and even cross regional territorial organizations(such as villages and townships, counties and cities, states, provinces and countries, etc.). This research aimed to measure the relative efficiency value of various decision-making units (DMU) within the same organization, and based on the investment and output of each DMU, calculate its relative efficiency value within the organization.

The relative efficiency value of each DMU is the ratio of its total output and investment in the organization. In determining weighting, the closer the calculated efficiency value is to the efficiency value of 1 determined by the research, the better. Through the best production curve, the relative efficiency of each DMU within an organization can be determined and inefficient DMU (efficiency value<1) can identify areas that need improvement. In addition, the best production curve can provide relatively inefficient DMU with a yardstick value, and list efficient units as learning models for inefficient DMU. Furthermore, to achieve higher efficiency value, some investment or output factors that are unfavor-

able to DMU might be neglected in the calculations, and weighted as 0, thus ignoring some critical factors. Hence, Charnes et al. (1979) proposed that the weight of all factors must be >0. On the other hand, Fare and Hunsaker (1986) pointed out setting the weight at a given value compromises general applicability.

Therefore literature review by this study found a large number of research that weighted according to cases. In 1979, the CCR model proposed by Charnes et al. (1979) used a weighted value set at >0. In 1984, Banker et al. modified the CCR model, and proposed the BCC model which asserts that when returns to scale changes, measures of technical efficiency eliminates the effects of scale efficiency. The BCC model has one more constraint than the CCR model in that by setting the total weight at 1, data are more closely enveloped. Thompson et al. (1990) proposed the AR model which allows upper and lower weightings between inputs and between outputs, thereby increasing differentiation and discrimination powers. Such method allows researchers to establish weightings, and can considered (Kao and Hung 2008).

This research adopted the AR model for its weighting selection features. Through in-depth interviews and focus group qualitative process, weightings among evaluation indicators were established to be u1, u2, and u3, respectively in weighting "employer satisfaction," "number of research publications" and "amount invested in research and industry-university programs;" of the three, the importance of "employer satisfaction" and "amount invested in research and industry-university programs" were weighted more than "number of research publications;" the importance of the weighted ratio of "employer satisfaction" u1 and "number of research publications" u2 was less than twice-fold; the importance of the weighting for "amount invested research and industry-university programs" u3 and "number of research publications" u2 was less than three-fold; and, the importance of "employer satisfaction" was similar to "number of research publications." The mathematical representation is as follows:

$$1 \leqq \frac{u_1}{u_Z}\ 2{,}1 \leq \frac{u_s}{u_Z}\ 3{,}1 \leq \frac{u_s}{u_Z} < 1.5 \quad \text{..... (1)}$$

In the relative importance of observed investment indicators, the number of full-time teachers and facilities and equipment investment amount were similar. However, in vocational education, both "number of full-time teachers" v1 and "facilities and equipment investment amount" v2 weighted more heavily than "annual departmental routine operational expenses" v3. The weighted ratio of "number of full-time teachers" v1 and "facilities and equipment investment amount" v3 was less than 2-fold; and the weighted ratio of "facilities and equipment investment amount" v2 and "annual departmental routine operational expenses" v3 was less than 3-fold. The mathematical representation is as follows:

$$1 \leqq \frac{v_1}{v_2} \leqq 1.5,\ 1 \leqq \frac{v_3}{v_2} < 3,\ 1 \leqq \frac{v_1}{v_3} \leqq 2 \text{.....(2)}$$

In Y1j, Y2j, Y3j, X1j, X2j, X3j, item j in the standardized measurement was based on "employer satisfaction," "departmental research and development achievement," "income from industries and university cooperation," and "number of full-time teachers," "facilities and equipment investment amount" and "departmental routine operating expenses." Applying the BCC (AR) model, the formula for calculating the efficiency value for Item k is expressed as:

$$E_k = \max\ u_1 Y_{1k} + u_2 Y_{2k} + u_3 Y_{3k}$$
$$\text{s. t } v_0 + v_1 X_{1k} + v_2 X_{2k} + v_3 X_{3k} = 1$$
$$(u_1 Y_{1k} + u_2 Y_{2k} + u_3 Y_{3k})$$
$$-(v_0 + v_1 X_{1k} + v_2 X_{2k} + v_3 X_{3k}) \leqq 0,\ j = 1.57$$
$$1 \leqq \frac{u_1}{u_Z}\ 2{,}1 \leqq \frac{u_s}{u_Z}\ 3{,}1 \leq \frac{u_s}{u_Z} \leq 1.5 \quad \text{..... (3)}$$

The efficiency obtained from this model is termed technical efficiency. Let v0 be set into the model, the obtained efficiency is termed aggregate efficiency. The ratio of technical efficiency and aggregate efficiency is termed scale efficiency, which can provide improvement grading for indicator items that were relatively inefficient in order to achieve optimal goal.

PERFORMANCE ANALYSIS AND RESULTS

Subjects

This research studied the performance of TH related departments in Taiwan's higher vocation-

al education. Therefore data was primarily obtained from the Ministry of Education Basic Database of Higher Technological and Vocational Education and supplemented with cross-comparison of surveys of department chairs to ensure data accuracy and representation. In addition, due to the diversity of academic systems among vocational institutes, such as 4-year technical colleges, 2-year technical institutes and 4-year technical institutes, and also because 4-year technical college curriculum is the current core of development for vocational education, this research examined the performance of TH departments of 4-year technical schools in the country in order to have a common basis for comparing performance evaluation. A review of vocational database of various departments for 2009 showed that because newly established departments were yet to have graduates, it was not possible to evaluate their resource investment efficiency and related indicators. Hence, to avoid assessment errors, departments that were established within the last three years were eliminated from the study. The performance of the resulting 57 TH departments of technical institutes with four year programs were evaluated and analyzed, and shown in Table 1.

Efficiency Analysis

Using mathematical formula (3), both functions and non-functions of the 57 situations were calculated. The aggregate efficiency and scale efficiency of the technical efficiency were obtained (which is the ratio of technical efficiency and scale efficiency). These results are shown in Table 2. Since this study adopted the restrictive AR model, the aggregate efficiency was low, with an average of only 0.5896. Only 6 schools (A6, A25, A31, A48, A56) showed relative efficiency, with efficiency value of 1. Of these schools, 4 were public and 2 were private, and 4 were technical colleges while 2 were technical institutes. Further observations of these 6 best performing schools showed that they scored higher than average in "employer satisfaction." Averaging the efficiency values of employer satisfaction, we obtained an average value of 0.36495, which was approximately 2.76 times higher than individual efficiency value of overall employer satisfaction, indicating that employer satisfaction was a major factor contributing to the higher efficiency value. Of the departments in the 6 schools, half was in TH department and the other half in recreation. Further observation of their performance indicators for investment and outputs showed that their amount invested in industry-university cooperation and student licensing were higher than their counterparts. In addition, they are State owned and showed high efficiency values for recreational departments and better overall performance.

In the five school departments that showed lower overall efficiency (A5, A17, A20, A40, A51), each had an average efficiency value of only 0.1781. These schools were private vocational institutes, and of the departments, three were in tourism and travel, one in tourism and hospitality, and one in recreation. The efficiency values for employer satisfaction and total number of research publications for these five institutes were averaged, obtaining low scores of 0.0135 and 0.1121, respectively. Hence, it can be seen that low employer satisfaction and low research and development publications were the main factors contributing to the low efficiency values of these five departments.

From the perspective of technical efficiency, 12 schools showed relative efficiency and 22 schools had aggregate efficiency of <0.5, with low technical efficiency, as shown in Table 2. In other words, their low efficiency was due to inefficient resource utilization. In terms of scale efficiency, 6 schools scored a perfect efficiency value of 1, implying that their aggregate and technical efficiency values were equivalent. From Table 2, we can see from their efficiency value that these schools do not need adjustment since their efficiency values have achieved sufficient relative efficiency, that is, optimal distribution.

The efficiency value of School K was (u1Y1k+u2Y2k+u3Y3k)/(v1X1k+v2X2k+v3X3k). Assuming that total investment (v1X1k+ v2X2k+v3X3k) was 1, other data were substituted according to our values. A function can be obtained, and the total output value is the efficiency value. Assuming optimal solution, then u and v are unique weightings of employer satisfaction, total number of research publications and total amount invested in research and industry-university cooperation contributed toward the total output value. In other words, aggregate ef-

ficiency value is the sum of the individual efficiency values of employer satisfaction, number of research publications and total amount invested in research and industry-university cooperation. This study further examined the efficiency values of these output items, and the amount invested in research and industry-university cooperation showed the highest value, with an average efficiency value of 0.1322, representing 58.4% of aggregate efficiency value. Employer satisfaction showed the second highest value, with an average efficiency value of 0.1322, representing 22.4% of the aggregate efficiency value. The number of research publications showed the lowest efficiency value, with an average efficiency value of 0.1129, representing 19.1% of aggregate efficiency value. The components of the efficiency of the various schools are listed in Table 2, which clearly shows the strengths and weaknesses of the three output indicators of various DMU, and indicates areas that need continual improvement.

This research classified the factors influencing educational performance into environmental characteristics and educational quality improvement strategies. Environmental characteristics refer to short term external factors that school managements were unable to change or control, such as ownership, location and nature of the departments. Educational quality improvement strategies refer to performance that can be changed by school managements. Using independent non-parametric Mann-Whitney test, the impact of unique environmental factor and educational quality improvement strategy on performance were respectively analyzed. Hence the strategic factor or environmental variable influencing the operational performance of the departments could be understood.

The 57 DMU were further classified according to the aforementioned environmental characteristics and educational quality improvement strategy. The Kruskal-Wallis test and Mann-Whitney statistical tests were conducted to test for significant difference in the DEA efficiency estimates for different classification conditions such as geographic condition, department attribute, and public or private school system. In addition, the impact of educational quality improvement strategies such as e-teaching platform, field practicum program, and forms of educational alliance strategies on operational performance was tested for significant difference. Table 3 shows the results of the analysis.

In the environmental characteristics, AE, TE and SE showed significant differences, implying that of technical colleges and vocational institute school systems, the overall efficiency, technical efficiency and scale efficiency of technical colleges were higher than those of technical institutes. In addition, departments that have implemented e-teaching, dual degree programs and educational alliance strategies showed significantly superior efficiency than those which did not implement such strategies. Field practicum programs showed no significant impact on performance, indicating that field practicum was not a major influencing factor.

From Table 3, the estimated DEA efficiency value of the Mann-Whitney U test showed that geographic conditions had no impact on the performance efficiencies of the departments, and that efficiency values of TH and recreation related departments were higher than that of tourism departments. In addition, there was significant difference between the efficiency values of public and private institutes; nevertheless, the difference was statistically insignificant, thereby indicating differences in departmental resource investment between public and private TH vocational education in Taiwan, thereby affecting output efficiency. After eliminating intervening variables, the efficiency measurements were more accurate, and thus also indicating that there was no difference between the efficiency of departmental resource utilization in public and private institutes. In the performances of technical colleges and institutes, technical colleges showed higher operational efficiency than institutes, possibly due to technical colleges being more able to achieve scale economy than institutes in their operations and having more extensive resource investments from the school. Using DEA to eliminate the impact of operational environment, the differences were even more significant, thereby indicating that the operational efficiency of technical colleges were definitely better than that of institutes.

Generally speaking, the results of the above analysis yielded three points worthy of discussion. First, results of management efficiency showed that the overall average efficiency value

Table 1: Basic data of 4-year technical college's TH related departments in Taiwan's higher vocational education

Location	*Nameof school*	*Name of department*	*Nature of department*	*Type of school*	*Ownership*
Northern Taiwan	Minghsin	Dep.of Leisure Management	Leisure	University of Science and Technology	Private
	Vanung	Dep. of Tourism and Leisure Management	Tourism and Travel, Leisure	University of Science and Technology	Private
	Jinwen	Dep. of Hotel Management	Hospitality	University of Science and Technology	Private
	Jinwen	Dep. of Travel Management	Tourism and Travel	University of Science and Technology	Private
	Jinwen	Dep. of Food and Beverage Management	Hospitality	University of Science and Technology	Private
	Jinwen	Dep. of Leisure and Recreation Management	Leisure	University of Science and Technology	Private
	Yuanpei	Dep. of Food and Beverage Management	Hospitality	University of Science and Technology	Private
	China	Dep. of Leisure and Recreation Management	Leisure	University of Science and Technology	Private
	De Lin	Dep. of Hospitality Management	Hospitality	Technical College	Private
	De Lin	Dep. of Leisure Management	Leisure	Technical College	Private
	China Institute	Dep. of Food and Beverage Management	Hospitality	Technical College	Private
	China Institute	Dep. of Tourism Management	Tourism and Travel	Technical College	Private
	ChingKuo	Dep. of Hospitality Management	Hospitality	Technical College	Private
	Chungyu	Dep. of Leisure, Recreation and Tourism Management	Leisure	Technical College	Private
	Hsing Wu	Dep. of Hospitality Management	Hospitality	Technical College	Private
	Hsing Wu	Dep. of Travel Management	Tourism and Travel	Technical College	Private
	Hsing Wu	Dep. of Tourism Management	Tourism and Travel	Technical College	Private
	Northern Taiwan	Dep. of Food and Beverage Management	Hospitality	Technical College	Private
	Taipei Maritime	Dep. of Food and Beverage Management	Hospitality	Technical College	Private
Central Taiwan	National Formosa	Dep. of Leisure and Recreation	Leisure	University of Science and Technology	National
	Chaoyang	Dep. of Leisure Services Management	Leisure	University of Science and Technology	Private
	Ling Tung	Dep. of Tourism and Leisure Management	Tourism and Travel, Leisure	University of Science and Technology	Private
	Hungkuang	Dep. of Hospitality Management	Hospitality	University of Science and Technology	Private
	National Taichung	Dep. of Leisure and Recreation Management	Leisure	Technical College	National
	Yu Da	Dep. of Leisure Management	Leisure	Technical College	Private
	TransWorld	Dep. of Tourism and Hospitality	Tourism and Travel, Hospitality	Technical College	Private
Southern Taiwan	Nan Kai	Dep. of Leisure Management	Leisure	Technical College	Private
	Chung Hwa	Dep. of Hospitality Management	Hospitality	University of Science and Technology	Private
	National Pingtung	Dep. of Hospitality and Recreation Management	Hospitality, Leisure	University of Science and Technology	National
	National Kaohsiung	Dep. of Tourism Management	Tourism and Travel	University of Science and Technology	National
	Tajen	Dep. of Hospitality Management	Hospitality	University of Science and Technology	Private

Table 1: Contd.....

Location	*Nameof school*	*Name of department*	*Nature of*	*Type of school*	*Ownership*
	Tajen	Dep. of Tourism Management	Tourism and Travel	University of Science and Technology	Private
	Chia Nan	Dep. of Hospitality Management	Hospitality	University of Science and Technology	Private
	Chia Nan	Dep. of Tourism Management	Tourism and Travel	University of Science and Technology	Private
	Shu-Te	Dep. of Leisure, Recreation and Tourism Management	Leisure	University of Science and Technology	Private
	Southern Taiwan	Dep. of Hospitality Management	Hospitality	University of Science and Technology	Private
	Far East	Dep. of Food and Beverage Management	Hospitality	University of Science and Technology	Private
	Tung Fang	Dep. of Tourism and Leisure Management	Tourism and Travel, Leisure	Technical College	Private
	Fortune	Dep. of Tourism and Leisure Management	Tourism and Travel, Leisure	Technical College	Private
	Tatung	Dep. of Leisure, Recreation and Tourism Management	Leisure	Technical College	Private
	Tatung	Dep. of Food and Beverage Management	Hospitality	Technical College	Private
	National Kaohsiung	Dep. of Leisure Management	Leisure	Technical College	National
	National Kaohsiung	Dep. of Travel Management	Tourism and Travel	Technical College	National
	National Kaohsiung	Dep. of Hotel Management	Hospitality	Technical College	National
	National Kaohsiung	Dep. of Air Transportation Management	Tourism and Travel	Technical College	National
	National Kaohsiung	Dep. of Hospitality Marketing Management	Hospitality	Technical College	National
	National Kaohsiung	Dep. of Food and Beverage Management	Hospitality	Technical College	National
	National	Dep. of Leisure Management	Leisure	Technical College	National
	Nan Jeon	Dep. of Hospitality Management	Hospitality	Technical College	Private
Eastern	*Dahan*	Dep. of Leisure Management	Leisure	Technical College	Private
Taiwan and	*Taiwan*	Dep. of Hotel Management	Hospitality	Technical College	Private
Offshore	*Hospitality*				
Islands	*Taiwan Hospitality*	Dep. of Food and Beverage Management	Hospitality	Technical College	Private
	Taiwan Hospitality	Dep. of Travel Management	Tourism and Travel	Technical College	Private
	Taiwan Hospitality	Dep. of Leisure Management	Leisure	Technical College	Private
	National Penghu	Dep. of Hospitality Management	Hospitality	University of Science and Technology	National
	National Kinmen	Dep. of Tourism Management	Tourism and Travel	University of Science and Technology	National

Table 2: Efficiency measures of TH related departments in four-year institutes of technology in Taiwan using AR-DEA Model

DMU	*Aggregate Efficiency(AE)*	*Technical Efficiency (TE)*	*Scale Efficiency (SE)*	*Employer satisfaction*	*Department research and development*	*Income from industry-university cooperation*
A1	0.4706	0.5647	0.8333	0.0853	0.1184	**0.2669**
A2	0.9819	1.0000	0.9819	0.3208	0.0406	0.6205
A3	0.512	0.6330	0.8088	0.1974	0.0203	0.2943
A4	0.6897	0.8450	0.8162	0.1823	0.1758	0.3316
A5	0.2273	0.4400	0.5166	0.0333	0.0167	0.1773
A6	1.0000	1.0000	1	0.205	0.2272	0.5677
A7	0.8820	0.8990	0.9811	0.08	0.1944	0.6075
A8	0.5430	0.7890	0.6882	0.1988	0.058	0.2862
A9	0.5056	0.8560	0.5907	0.129	0.1184	0.2583
A10	0.8878	1.0000	0.8878	0.0952	0.3614	0.4311
A11	0.2439	0.3450	0.707	0.0075	0.0472	0.1892
A12	0.2924	0.3890	0.7516	0.0123	0.0358	0.2444
A13	0.359	0.4670	0.7688	0.2653	0	0.0937
A14	0.432	0.5970	0.7236	0.0157	0	0.4163
A15	0.3199	0.4340	0.7371	0.0071	0.0888	0.2241
A16	0.3938	0.5430	0.7253	0.0022	0.1287	0.263
A17	0.0451	0.0563	0.8011	0.0003	0.0004	0.0444
A18	0.4985	0.5831	0.8549	0.0483	0.1462	0.304
A19	0.657	0.7560	0.869	0.2117	0.1109	0.3344
A20	0.1676	0.3420	0.49	0.0321	0.0221	0.1134
A21	0.897	1.0000	0.897	0.0036	0.3491	0.5444
A22	1	1.0000	1	0.3835	0.2564	0.3601
A23	0.783	0.8840	0.8857	0.3313	0.0822	0.3695
A24	0.7322	0.8245	0.888	0.1833	0.0862	0.4627
A25	1	1.0000	1	0.1816	0.4806	0.3378
A26	0.7379	0.8831	0.8356	0.085	0.1866	0.4663
A27	0.3403	0.5370	0.6337	0	0.0266	0.3137
A28	0.7398	0.9975	0.7416	0.1412	0.2491	0.3494
A29	0.2843	0.3765	0.7551	0.1426	0.1417	0
A30	0.8765	1.0000	0.8765	0.3719	0.1009	0.4038
A31	1	1.0000	1	0.5363	0.1631	0.3006
A32	0.7689	0.8790	0.8747	0.0193	0.2189	0.5307
A33	0.5634	0.7647	0.7368	0.0064	0.0645	0.4925
A34	0.4765	0.7659	0.6221	0.1146	0.0722	0.2897
A35	0.4335	0.5202	0.8333	0.2102	0.0371	0.1862
A36	0.6987	0.8232	0.8488	0.3286	0.0641	0.306
A37	0.6902	0.8946	0.7715	0.2495	0.092	0.3487
A38	0.4767	0.6397	0.7451	0.0974	0.1697	0.2096
A39	0.5296	0.6267	0.8451	0.0137	0.1974	0.3185
A40	0.2409	0.3799	0.634	0	0.0212	0.2196
A41	0.3086	0.4388	0.7032	0.0019	0.0426	0.2641
A42	0.6812	0.7589	0.8976	0.0099	0.0132	0.6581
A43	0.7015	0.8576	0.818	0.081	0.1345	0.486
A44	0.7934	0.8825	0.899	0.3507	0.0543	0.3884
A45	0.7345	0.9347	0.7858	0.0339	0.1244	0.5762
A46	0.5974	0.7357	0.812	0.0943	0.1268	0.3764
A47	0.6184	0.7931	0.7797	0.1777	0.0206	0.42
A48	1	1.0000	1	0.5554	0.0161	0.4284
A49	0.5812	0.7329	0.793	0.0493	0.2046	0.3274
A50	0.3421	0.4895	0.6989	0.058	0	0.2841
A51	0.2096	0.3571	0.5869	0.0019	0.0029	0.2048
A52	0.6278	0.8341	0.7527	0.0171	0.2704	0.3403
A53	0.5322	1.0000	0.5322	0.0291	0	0.5031
A54	0.2532	0.5732	0.4417	0.0044	0.0164	0.2324
A55	0.2898	0.4391	0.66	0.0002	0.0636	0.2262
A56	1	1.0000	1	0.4923	0.0871	0.4206
A57	0.9578	1.0000	0.9578	0.0485	0.2871	0.6222
Average	**0.5896**	**0.7222**	**0.7908**	**0.1322**	**0.1129**	**0.3445**

Table 3: Variance analysis of efficiency value in educational quality improvement strategies and types of departmental educational environment

Type	*Category*	*No. of depart-*	*Aggregate efficiency*	*Technical efficiency*	*Scale efficiency*	*TE of M-W U (P)*
Type	1.University of Sci.andTech.	25	0.6980 (0.2378)	0.8160 (0.1882)	0.8364 (0.1389)	174.5 (0.204)
	2.Technical College	32	0.5049 (0.2468)	0.6489 (0.2498)	0.7552 (0.1300)	
Location	1.Northern Taiwan	20	0.5055 (0.2724)	0.6270) (0.2605)	0.7767 (0.1399)	156.2 (0.098)
	2.Central Taiwan	9	0.7238 (0.2566)	0.8336 (0.2269)	0.8485 (0.1212)	
	3.Southern Taiwan	22	0.6056 (0.2196)	0.7398 (0.1989)	0.9290 (0.02012)	
	4.Eastern Taiwan and Offshore Islands	6	0.6101 (0.3191)	0.8077 (0.2459)	0.7241 (0.2246)	
Nature of Department	1. Hospitality	22	0.6350 (0.2460)	0.7839 (0.2094)	0.7876 (0.1455)	145.2 (0.072)
	2. Leisure	19	0.5888 (0.26957)	0.7165 (0.2536)	0.7939 (0.1235)	
	3. Tourism	16	0.5282 (0.2690)	0.6439) (0.2471)	0.7915 (0.1491)	
Ownership	1. National	13	0.8275 (0.1648)	0.9182 (0.1062)	0.8938 (0.0898)	132 (0.061)
	2. Private	44	0.5193 (0.2407)	0.6642 (0.2360)	0.7604 (0.1345)	
E-teaching	1. Yes	28	0.7808 (0.1741)	0.8962 (0.1961)	0.8656 (0.1091)	54 (0.000)***
	2.No	29	0.4050 (0.1832)	0.5541) (0.1265)	0.7186 (0.1229)	
Strategic Alliance	1.Yes	10	0.6222 (0.2527)	0.7540) (0.2207)	0.7986 (0.1403)	144.5 (0.051)*
	2.No	47	0.4364 (0.2468)	0.5723 (0.2714)	0.7541 (0.1207)	

Note: 1. () indicates standard deviation.2. *p<0.05, **p<0.01, ***p<0.001

of the 57 TH related departments in 4-year technical colleges in Taiwan showed a high of 0.78, leaving 22% room for improvement in their resource utilization. This finding indicates that the resource utilization of TH education needs improvement. In addition, public systems have more idle resources than private systems, "technical colleges" have more advantageous operating environment, and "institutes" have less advantageous operating environment. Assessment of the nature of operation showed that the location and type of school system were statistically insignificant, while introduction of e-learning platform for online teaching and international strategies for TH education strategic alliance resulted in better operational output.

CONCLUSION

Higher vocational education in tourism plays a critical role in the development of a nation's tourism industry. Each school must not only value the professional education of students, but must strengthen the utilization of limited educational resources. This study used the Data Envelopment Analysis method to evaluate the performance of various teaching units in TH related departments in domestic 4-year technical

schools. The efficiency of resource investments and output were analyzed, and through empirical analysis using the DEA, the obtained data provided participating departments information of their relative efficiency, which is useful as short term evaluation indicators and basis for long term goals, thus establishing a model for improving the competiveness of TH vocational education and self assessment. Using the basic DEA model and AR model, a valid and accurate assessment and control of schools departmental resource utilization was made. Using the AR-BCC model, the relevant weightings among the indicators of various teaching units were adjusted to provide an even more suitable method for evaluating the departmental performances of technical schools. Such performance evaluations not only allow managements to understand the relative efficiency of resource utilization by various school departments, but can also delineate a benchmark department as learning goals, and help departments with lower performance diagnose their problems and provide direction for improvement. Optimal utilization of limited resources and producing satisfactory output can enhance the competitiveness of schools and help them strive for more resources, and thereby sustaining their operation.

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