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Introduction

American and Western European investors have generally been aware of emerging producers in the Far East and Southeast Asia, and also that this region was poised for continued future growth (Rzadzki, 1994). Specific countries identified as emerging producers in this region were China, India, Singapore, Indonesia, Malaysia, Thailand, Vietnam, Korea and Taiwan (Rzadzki, 1994). All these countries have experienced significant economic growth since World War II, some more dramatically than the rest. Specifically, in the case of Taiwan, Republic of China (R. O. C.), the per capita gross national product rose from $50 in 1952 to $6400 in 1988. As of 1987, the trade level of Taiwan was $89 billion, with a surplus of $19 billion, and foreign exchange reserves have reached $70 billion, then one of the largest levels for any country in the world (Wu, 1991). However, since that time, Taiwan has continually faced challenges from countries in Asia and around the world to maintain high levels of economic advantage ("Taiwan-the dream postponed," 1993).

Juran (1995) noted that where as the 20th century became famous for world productivity, the 21st century would become well known as the "century for quality." Ishikawa of Japan believed that education was the most important factor in increasing the level of awareness for quality (Ross, 1995). In the United States, the number of educational institutions offering courses in total quality steadily rose during the 1990s. In addition to quality-related instruction, the system of total quality management (TQM) even became the adopted way of managing educational institutions. Numerous success stories following the implementation of a TQM style of management have appeared in the literature. The influence of TQM in improving the educational programs at George Westinghouse Vocational Technical High School in Brooklyn, New York, provided an example of such positive transformations ("Back to school," 1994).

In an era of global free trade where geographic barriers in terms of technology transfer were easily overcome, competitive success depended more on the talent and ability of the people rather than latest available technologies (Thurow, 1996). Therefore, education and training of skilled workers were considered highly important (Cheng, 1992/93). In the United States, community colleges were recognized as the most responsive group to the needs of business and its employees (Boyes, 1981). These institutions have been quite active in implementing a total quality curriculum and providing superior preparation of personnel for the workplace of the 21st century (Miller & Daniels, 1998). In Taiwan, much of the responsibility for workforce training and development belongs to nationally established vocational training centers. These institutions are yet to implement total quality-related instruction in their training programs.

Among Taiwanese firms, most large corporations have the resources to provide customized training for their employees, and small and medium scale corporations usually do not have training facilities of their own. Therefore, vocational training centers (established and sponsored by the government) have a major responsibility to prepare the present and future workforce for medium and small-scale companies based in Taiwan. At the present time, such centers do not offer training that addresses TQM concepts and/or associated methodologies for continuous improvement of processes (Employment and Vocational Training Administration, 1997; Catalog of Vocational Training Centers, 1998; Lin, 1998). It is not exactly known why these centers have not actively pursued the inclusion of TQM in their training curriculum. At the same time, competitors in the United States and Japan

have been proactive in educating workers at all levels in TQM and problem solving skills for continuous improvement of processes. If adequate continuing education with respect to quality must be provided to a majority of workers in Taiwan, the vocational training centers must assume leadership.

Purpose of This Study

The first purpose of this study is to identify the degree of importance of teaching an established core body of knowledge in TQM concepts and skills to trainees who attend the vocational training centers as perceived by the instructors at the vocational training centers (VTCs) and by the leaders of companies that have sent their employees to VTCs in Taiwan. Secondly, the study also seeks to find the level of preference for potential learning opportunities to improve instructors' knowledge of TQM principles and methods as perceived by the instructors at VTCs and by the leaders of companies. Finally, the study asks the instructors at VTCs and the leaders of companies to express their degree of agreement with strategies that might be used to include TQM practices into the VTCs' curriculum.

The study attempted to answer the following questions:

(1) What is the degree of importance of teaching an established core body of knowledge in TQM concepts and skills to trainees who attend the vocational training centers as perceived by the VTCs' instructors and companies' leaders?

(2) What is the level of preference for potential learning opportunities to improve instructors' knowledge of TQM principles and methods as perceived by the VTCs' instructors and companies' leaders?

(3) What is the degree of agreement with strategies that might be used to include TQM practices into the VTCs' curricula as perceived by the VTCs' instructors and companies' leaders?

(4) Do the perceptions of the degree of importance of teaching an established core body of knowledge in TQM concepts and skills to trainees who attend the VTCs differ between the VTCs' instructors and companies' leaders?

(5) Do the perceptions of level of preference for potential learning opportunities to improve instructors' knowledge of TQM principles and methods differ between the VTCs' instructors and companies' leaders?

(6) Do the perceptions of the degree of agreement with strategies that might be used to include TQM practices into the VTCs' curriculum differ between the VTCs' instructors and companies' leaders?

Methodology of the Study

Population and Sample of the Study

Participants of the study included the instructors of thirteen vocational training centers of Taiwan and leaders from companies that have sent their employees to vocational training centers. There were approximately 500 instructors in the thirteen vocational training centers (centers were selected as an entire population). This included Assistant, Associate, and Full instructors (Employment and Vocational Training Administration, 1997).

Recognizing that companies' leaders included President, Vice President, and Manager, the leaders identified in the approximately 150 companies (companies were selected as a purposive non-random sample) numbered around 450 (Ministry of Economic Affairs, 1997). This selection criterion was based on the literature review, which indicated that those companies found it economically unfeasible to offer their own training programs due to the cost of materials and personnel resources.

A mailed survey was used to collect the data to determine the perceptions of the feasibility of TQM theories and methodologies in the vocational training systems as perceived by the centers' instructors and the leaders of companies. From the 13 regional VTCs sampled, 365 responses were obtained (a 69.4% rate) and 95 responses were obtained from company personnel (a 21% return rate.)

Variables of the Study

The dependent variables of the study were:

(1) the degree of importance of teaching an established core body of knowledge in TQM concepts and skills to trainees who attend the VTCs;

(2) the level of preferences for potential learning opportunity to improve instructors' knowledge of TQM principles and methods; and

(3) the degree of agreement with strategies that might be used to include TQM practices into the VTCs' curriculum. The independent variables are listed in Table 1.

Instrument Development

In 1991, two hundred academic and industry leaders conducted a joint session to identify ways to accelerate the teaching, research, and practice of total quality in the United States (The Procter & Gamble Company, 1992). An important outcome of this meeting was the formation of a Total Quality Leadership Steering Committee and the formation of working councils to address crucial TQM areas. The Leadership Steering Committee released a publication, titled "A Report of The Total Quality Leadership Steering Committee and Working Councils" (The Procter & Gamble Company, 1992). This report contained a section exclusively addressing the needs of industry in relation to the methodologies and principles of TQM that should be incorporated into business, engineering, and related other curriculum. The eight clusters identified in the Leadership Steering Committee's report have also formed the basis for more recent studies in total quality education (Evans, 1996; Weinstein et al., 1998). All eight factors described as clusters were assumed to be of equal importance. This observation of eight clusters was identified as the best available model for writing an initial set of items (1-48) that would answer specifically TQM content-related research questions posed in this study. The cluster

descriptions are shown in Table 2. Three major sub-scales were constructed from the eight concept clusters and are identified as:

(1) Core body of knowledge of TQM (items 1 - 48 with Alpha reliability .97),

(2) Instructor preferences for TQM learning opportunities (items 49-58 with Alpha reliability .91), and

(3) Strategies for including TQM into curriculum (items 59 - 67 with Alpha reliability .93.)

The overall instrument Cronbach Alpha reliability obtained for the 67 items was .98.

Data Analysis

To test the hypotheses that the scale 1, scale 2, and scale 3 had equal means for groups defined by eight categorical independent variables (job titles, levels of education, years of working experience, hours of training of TQM of VTCs' instructors, location, type of training program, type of sponsoring agency, and number of students at the center), one-way analyses of variance (ANOVA) were conducted at the 95% confidence level. Thus, there were eight ANOVAs completed for each of the three scales. These analyses were all performed on the sample of responses obtained from the VTCs' instructors. Scheffe' post-hoc comparisons among groups were also performed at the 95% confidence level in order to determine which, if any, simple contrasts among groups were significant. These eight analyses were conducted separately for respondents from VTCs and from industries yielding a total of 16 fixed-effects ANOVAs.

To compare VTC and industry personnel perceptions, analyses of covariance were conducted to test the equality of means for the scales 1 through 3. The F-test at the 95% confidence level was utilized. The covariates selected were demographic data common to both centers' and companies' respondents. These were:

(1) Levels of education;

(2) Years of working experience;

(3) Hours of training in TQM; and

(4) Size of organization as measured by number of students or number of employees.

To identify the specific levels of importance attached to individual items by VTC and industry personnel, the means and standard deviations of the 67 items were examined. Items were then categorized into highly positive, positive and neutral in importance based on the 7-point scale for each item (1 = Not important, Low preference, or Strongly disagree to 7 = Very important, High preference, or Strongly agree .)

Findings of the Study

Of the 3 x 8 or 24 ANOVAs completed for the VTC personnel, seven overall tests of equal means were rejected at the .05 level. Significant differences were found for Scale 1 for levels of degree earned, total hours of TQM training, region of the country, and government or non-government sponsorship. Equality of means for Scale 3 was rejected for both levels of degree earned and country region. Scale 2 was significant only for region. Table 3 summarizes the findings for vocational technical college personnel.

For industry personnel, only Scale 2 was found to be significant for degree earned and type of industry. Table 4 summarizes the findings for industry personnel.

When comparing VTC and industry personnel on each scale with means adjusted for four covariates, significant differences were found for scale 1 (see Table 5.)

Tables 6 and 7 summarize the perceptions of VTC and industry personnel on individual items grouped into the 8 conceptual groups which formed the basis for the 67 item instrument. Table 8 presents the individual item means and standard deviations for the entire instrument Table 9 presents the average item means for items in each of the three scales.

Implications of the Study

The results of this study suggested that both the instructors at VTCs and the leaders at companies held positive perceptions on the three scales consid-

ered in the study, namely the core body of knowledge of TQM, TQM learning opportunities, and strategies for including TQM into curriculum. From the item analysis of the instrument, the following ten items of core body of knowledge of TQM were rated most highly positive by the instructors at VTCs and the leaders at companies: (1) teamwork and people involvement; (2) understanding customer expectations and requirements; (3) measurement of customer satisfaction; (4) consensus development; (5) knowledge of oneself; (6) continuous improvement; (7) personal commitment and responsibility; (8) development of new knowledge; (9) product design for quality; and (10) proactively seeking feedback from customers.

Companies' leaders rated more positively than VTCs' instructors did on the perceptions of core body of knowledge of TQM. There were significant differences on perceptions of core body of knowledge of TQM among VTCs' instructors with respect to levels of education, hours of TQM training, location of center, and type of sponsoring agency of center. The leaders having 11-15 years of working experience perceived the core body of knowledge as most importance issues for VTCs.

This study highlighted the importance of strategies for including TQM into the curriculum. There were significant differences on strategies for including TQM into curriculum among the instructors with respect to levels of education and location of centers. The leaders with college degree and from the other type of product of company perceived the strategies for including TQM into curriculum as most important issues for VTCs.

There were significant differences on the perceptions of TQM learning opportunities among companies' leaders with respect to levels of education and type of product of company. There were significant differences on the perceptions of TQM learning opportunities among VTCs' instructors with respect to location of center.

Companies should become proactive in partnering with vocational training centers in providing TQM learning

opportunities for the instructors at VTCs. This is particularly important as several companies already have exposure to TQM. As a whole, companies have endorsed the view that vocational training centers should teach TQM knowledge and skills to their employees. It is reasonable to expect business and industry of Taiwan to become more actively involved and extend full co-operation with vocational training centers in implementing TQM theories and methodologies. It is worthy to note here that in the United States several industry-academy partnerships emerged during the 1980s and 90s. Many companies played a major role in making TQM education become increasingly popular in academic institutions within the United States.

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Table 1. Independent variables of the study

Independent Variables
Job titles of the centers' instructors
Job titles of the companies' leaders
Levels of education of the centers' instructors
Levels of education of the companies' leaders
Years of working experiences of the centers' instructor
Years of working experiences of the companies' leaders
Hours of training of TQM of the centers' instructors
Hours of training of TQM of the companies' leaders
Location of the training centers
Type of training programs at the centers
Type of sponsoring agency of the centers
Number of students at the centers
Location of the companies
Type of products at the companies
Type of ownership category of the companies
Number of employees at the companies

Table 2. Factors defining total quality orientation and knowledge (The Procter & Gamble Company, 1992, p. 3-5)

Cluster	Description
Customer orientation (ITEM 1-6)	Customers- their needs and our solutions to their problems-are why organizations exist; all employees must continually strive to improve satisfaction
Practical knowledge and application of TQM tools (ITEM 7-12)	Hands-on skill in using Total Quality processes and tools within a business context
Fact-based decision making (ITEM 13-18)	The need for the right data at the right time for the right action; asking "What do I need to know?" and "How will I act on the information?"
Understanding of work as a process (ITEM 19-24)	Work is a process organized around outcomes; as a process, work can be improved and refined-even radically overhauled-to achieve improvement
Team orientation (ITEM 25-30)	Ability to work effectively with others; minimize unproductive conflict while encouraging diverse opinions and constructive debate; valuing the greater good of the company above personal, unit, or functional goals
Commitment to improvement (ITEM 31-36)	Continuously striving for improvement, from the small and incremental to the big breakthroughs
Active learner (ITEM 37-41)	Learning is central to success; ability to gain insight by reflecting on successes and failures; to learn from co-workers, competitors, and customers
Systems perspective (42-47)	Ability to see the "the big picture," across hierarchical, organizational, and functional boundaries

Table 3. Summary of significant findings for Vocational Technical School personnel.

Variables	Core body of knowledge of TQM	TQM learning opportunities	Strategies for including TQM into curriculum
1. Job titles			
2. Levels of education	(4)>(2) (4)>(3)		(4)>(3)
3. Years of working experience			
4. Hours of TQM training			
5. Location	(1)>(2) (1)>(3)	(1)>(2) (1)>(3)	(1)>(2) (1)>(3) (3)>(2)
6. Type of training program			
7. Type of sponsoring agency	(2)>(1)		
8. Number of students			

*numbers in parentheses represent groups (variable categories)

Table 4. Summary of findings for industry personnel

Variables	Core body of knowledge of TQM	TQM learning opportunities	Strategies for including TQM into curriculum
1. Job titles			
2. Levels of education		(4)>(3)	
3. Years of working experience			
4. Hours of TQM training			
5. Location			
6. Type of training program			
7. Type of sponsoring agency			
8. Number of students			

*numbers in parentheses represent groups (variable categories)

Table 5. Analysis of covariance results for scale 1 to compare VTC and industry personnel.

Variables		Sum of squares	df	Mean square	F	Sig.	B
Scale 1 Covariates (Combined)		34194.9	4	8548.731	5.455	.000	
Years		10037.3	1	10037.3	6.405	.012	-4.258
	Size	65.266	1	65.266	.042	.838	.386
	Hours	6259.491	1	6259.491	3.994	.046	3.615
	Degree	22519.4	1	22519.4	14.369	.000	11.462
Main effects	Sujects	7660.088	1	7660.088	4.888	.028*	
Model		5099.4	5	10198.5	6.507	.000	
Residual		686434	438	1567.202			
Total		737427	443	1664.620			

United method spans the header above Sum of squares through B.

Table 6. Summary of the perceptions of the feasibility of implementing TQM training among VTCs' instructors

Variables	Core body of knowledge of TQM	TQM learning opportunities	Strategies for including TQM into curriculum
1. Job titles	**	**	**
2. Levels of education	**	**	**
3. Years of working experience	**	**	**
4. Hours of TQM training	**	**	**
5. Location	**	**	**
6. Type of training program	**	**	**
7. Type of sponsoring agency	**	**	**
8. Number of students	**	**	**

*highly positive: mean-values of item are 6.00 - 7.00

**positive: mean-values of item are 5.00 - 6.00

***neutral; mean-values of item are 4.50 - 5.00

Table 7. Summary of the perceptions of the feasibility of implementing TQM training among companies' leaders

Variables	Core body of knowledge of TQM	TQM learning opportunities	Strategies for including TQM into curriculum
1. Job titles	**	**	**
2. Levels of education	**	** Bachelor degree	*College degree
3. Years of working experience	*11-15 years	**	**
4. Hours of TQM training	**	***21-30 hours	**
5. Location	**	**	**
6. Type of product	**	**	*Other product
7. Type of ownership category	**	**	**
8. Number of employees	**	***501-1000 employees	**

*highly positive: mean-values of item are 6.00 - 7.00

**positive: mean-values of item are 5.00 - 6.00

***neutral; mean-values of item are 4.50 - 5.00

Table 8. Items means and standard deviations (items listed in descending order of means)

Order	Item #	Brief description of item	Mean	SD
1	Item 25	Teamwork and people involvement	6.1351	1.1500
2	Item 2	Understanding customer expectations and requirements	6.1194	1.1969
3	Item 5	Measurement of customer satisfaction	6.0293	1.1169
4	Item 30	Consensus development	6.0068	1.1353
5	Item 38	Knowledge of oneself	5.9887	1.1050
6	Item 31	Continuous improvement	5.9842	1.1666
7	Item 40	Personal commitment and responsibility	5.9572	1.1542
8	Item 37	Development of new knowledge	5.9347	1.1214
9	Item 32	Product design for quality	5.9279	1.1320
10	Item 4	Proactively seeking feedback from customers	5.9257	1.2982
11	Item 27	Team-building skills	5.8874	1.1738
12	Item 26	Leaders skills	5.8559	1.2397
13	Item 35	Relationship between continuous improvement and global competition	5.8446	1.2282
14	Item 13	Plan-do-check-act cycle	5.8401	1.2331
15	Item 24	Process control concepts	5.8108	1.1755
16	Item 67	The processes for anticipating and responding to future requirements of industry are important for vocational training centers	5.7950	1.1814
17	Item 48	How important you feel it is to teach TQM to trainees at training centers	5.7838	1.1918
18	Item 12	Activity-based cost management concepts	5.7523	1.2577
19	Item 61	The practice of quality principles should encompass everything from continuous improvement of the administrative functions to the process for curriculum development to the teaching methods used in the classroom	5.7320	1.2086
20	Item 47	ISO 9000 standards for quality systems	5.7185	1.2186
21	Item 63	Vocational training centers should treat companies that send their employees to the centers as customers and seek their feedback for improvement	5.6982	1.2512
22	Item 1	Identifying customers	5.6937	1.4429
23	Item 6	Relationship between employee satisfaction and customer satisfaction	5.6847	1.2958
24	Item 66	Having a strong and involved leaders at vocational training centers is the key to successful implementation of TQM curriculum	5.6824	1.2518
25	Item 65	All stakeholders including faculty, staff, and students at the centers must be actively involved in the learning process of TQM from the beginning of the program	5.6802	1.2467
26	Item 29	Employee empowerment	5.6779	1.2525
27	Item 46	Organizational goals and outcomes	5.6509	1.2140
28	Item 60	Vocational trainers should emphasize interdisciplinary faculty teams to teach quality to trainees	5.6374	1.2340
29	Item 28	Team-meeting (facilitation) skills	5.6284	1.2332
30	Item 39	Dealing with organizational change	5.6284	1.2277
31	Item 15	Cost of quality (Prevention cost, Appraisal cost, Failure cost, etc.)	5.6059	1.2977
32	Item 62	Vocational training centers should establish "Quality Improvement Teams" to facilitate continuous improvement of their training programs	5.6036	1.2097
33	Item 34	Importance of design and re-design of processes	5.5946	1.2067
34	Item 42	Systems thinking	5.5923	1.1861
35	Item 22	Measuring processes	5.5878	1.2183
36	Item 41	Understanding learning styles	5.5698	1.2397
37	Item 64	Curriculum revision should involved researching the requirements of students, parents, society, alumni, employers, and faculty	5.5698	1.2667
38	Item 59	The teaching of quality must be integrated within the contents of individual courses as well as across the entire curriculum	5.5383	1.2875
39	Item 21	Difference between building in quality and inspecting in quality	5.5045	1.3244
40	Item 11	Design of experiments	5.4820	1.3972
41	Item 14	Understanding variation	5.4640	1.2752
42	Item 36	Cross-functional interaction	5.4347	1.2508
43	Item 45	Organizational mission statement	5.4324	1.2307
44	Item 20	Flowcharting and process mapping	5.4279	1.3309

Table 8. Items means and standard deviations (items listed in descending order of means) (continued)

45	Item 51	Training center faculty members would spend 1-4 months at a leading TQM company or college/university studying the TQM practice	5.4167	1.3438
46	Item 9	Quality control tools (Pareto diagram, Cause-and-effect diagram, Histogram, etc.)	5.4077	1.3160
47	Item 17	Recognizing data patterns and their implications	5.4009	1.2540
48	Item 49	An industry executive with TQM expertise would work on-site at a training center for a 6-12 month period to provide TQM education to the faculty	5.3784	1.3391
49	Item 58	A TQM resource guide including class outlines and materials, reading, and teaching notes that represent alternative approaches being used in higher education and companies would be produced for vocational training centers' faculty.	5.3716	1.2423
50	Item 56	Training center faculty would attend 2-3 days TQM courses on campus (typically 25 participants per course) that are similar to those that businesses normally provide to their employees. These courses will be provided directly by companies, professional associations, or consultants that normally provide TQM education to business.	5.3626	1.2576
51	Item 8	Selection of statistical process control tools	5.3514	1.3364
52	Item 10	Management and planning tools (Arrow diagram, Tree diagram, Matrix diagram, etc.)	5.3221	1.3429
53	Item 52	A series of (3-5) two-hour television broadcasts aimed at establishing the basic steps that can be taken to incorporate TQM into the training center's curriculum will be presented	5.3176	1.3083
54	Item 7	Definitions of quality according to experts and scholars	5.3131	1.2885
55	Item 16	Root-cause analysis	5.3018	1.3350
56	Item 19	Concepts focusing on process rather than product	5.3018	1.3282
57	Item 57	Workshops would be sponsored by professional TQM societies/organizations that focus on specific issues of TQM such as strategic planning, emerging curricula topics, strategies for developing teamwork, quality indicators, benchmarks, and implementation	5.2703	1.2128
58	Item 23	Difference between common and special causes	5.2680	1.3090
59	Item 50	A senior faculty member from a college or university with real world TQM experience would work at a training center for a 6-12 month period to provide TQM education to the faculty	5.2455	1.3474
60	Item 53	A one-week session would be sponsored by professional TQM societies/ organizations and taught by university faculty, industry executives, TQM experts and scholars from around the world. The objectives are to build awareness of TQM concepts and explain the approaches for incorporating TQM into the training center's curriculum	5.2117	1.3030
61	Item 54	A critical mass (35%-75%) of training center faculty members would visit a company for 4-5 days with the purpose of learning about TQM. Following this initial experience, an ongoing relationship (every week for two years) with the company for the continued learning about TQM would be established. This would include sharing of TQM education through the company's classes and the opportunity to observe and participate in the TQM practice at the company	5.1937	1.3365
62	Item 33	Difference between small and large quality improvements	5.1734	1.4235
63	Item 3	Difference between internal and external customers	5.1509	1.4402
64	Item 18	Operational definition (A definition that gives communicable meaning by specifying how the concept is measured and applied within a set of circumstances)	5.1464	1.3584
65	Item 44	Quality Award criteria (Baldrige Award, Deming Prize, etc.)	5.0766	1.3433
66	Item 55	Training center faculty would attend conferences of 200-800 participants sponsored by higher educational institutions, TQM-oriented organizations/ societies, or business associations to learn about TQM	4.9369	1.4460
67	Item 43	Theory of constraints	4.8896	1.3865

*Mean: 1 = Not important, Low preference, Strongly disagree
*Mean: 7 = Very important, High preference, Strongly agree

Table 9. Sub-scale means and standard deviations

Name of scale (construct)	Number of items	Mean (item)	Standard deviation (item)
Core body of knowledge of TQM	48 (no. 1-48)	5.61	0.85
Instructor preferences for TQM learning opportunities	10 (no. 49-58)	5.27	0.98
Strategies for including TQM in the curriculum	9 (no. 59-67)	5.66	0.99