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QUALITY IMPROVEMENT APPROACH FOR REVIEWING THE EFFECTIVENESS OF CURRICULA

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ABSTRACT

It is common to adopt group discussions when determining whether a curriculum conforms to the needs for cultivating students' competences; however, definitive methods of analysis that can confirm the correlation between competences and curricula are lacking. The purpose of this research was to introduce a quality improvement approach of core competence and curricula for student employment that could be used to continuously review the curricula for information management. The research methods included the establishment of core competences via behavioural event interviews, focus groups and the investigative research method, as well as an exploration of the curriculum for student employment used in technological universities and the establishment of a quality improvement approach based on Grey Relational Analysis (GRA). The research obtained six items of core competences and six types of curricula for employment, and established a quality improvement approach for core competence and curricula based on the results of GRA.

Keywords: Core competence, Curriculum, Quality, GRA

INTRODUCTION

Core competence is the basis for organizational restructuring as well as the driving force after changes to enterprises' organizational strategies, and it is also a common issue of interest for administrators and scholars (Ljungquist, 2007). Studies on competence have been highly emphasized since D. McClelland (1973), proposed the Job Competence Assessment Method, which was meant to find the competence factors that allowed the achievement of high performance from enterprise administrators and workers. Spencer & Spencer (1993) also proposed the Competence Model and believed that the competences required to conduct certain work can be found through job analysis, duty analysis and task analysis. These treatises have provided a high degree of guidance for competence-based theory and its methodology and have enabled the research of competence to be highly systematic.

Recent studies on horizontal cross-sections of competences have clearly revealed the categories of competences and their compositional elements, which are helpful for full control of the contents of competences at the workplace (Lei & Slocum, 1992; Gibbs, 2009; Chang, 2012), as well as the need for continued development of curricula to support learning and frequent reviews of whether learning and curricula are connected on the same track (Chang, & Chang, 2011; Okendu, 2012). However, researches on vertical cross-sections of competences have emphasized the economic functions of higher education and laid emphasis on how individual competences could be close to the needs of the workplace to enhance individual employability, with emphasis on how students' competences could be enhanced through systematic curriculum planning and design (Kristensen, 2010; Chang, 2013).

How to maintain a high degree of correlation between core competence and curricula for students in the field of engineering is an important issue in curricular planning and design (Washer, 2007). Brennan (2004) pointed out that core competences are the key issues in the preliminary design of university curricula. Curriculum design is more than just the correct logical arrangement of subjects; students are important factors of curriculum design (Luxon & Peelo, 2009; Bantu *et al*., 2012).

Therefore, the purpose of this research was to introduce a quality improvement approach of core competence and curricula for student employment that could be used to continuously review the information management curricula at technological universities. The establishment of the approach followed three major steps: 1) establishing the core competences that information graduates should have; 2) exploring the current status of the curricula for student employment implemented at technological universities; and 3) conducting an analysis of the correlation between the core competences and the curricula for student employment, so as to build a quality improvement approach for a continuous review of the curriculum's effectiveness.

Core Competence

Competency and competence are different. As Hafeez and Essmail (2007) pointed out, innovative solutions, core competences, customer focus and a team orientation are mostly related to individualized competency. For example, students in college education should possess the eight core competences of critical and creative thinking (Chang, 2013). Competence is considered to be a general work-related concept that can be applied to all behaviours, motivations and knowledge in relevance to the success or failure of a job (Chang, 2012). Ljungquist (2007) proposed that the definition of core competence should satisfy the following three criteria: 1) it should contribute significantly to customer benefit from a product; 2) it should be competitively unique; and 3) it should provide potential access to a wide range of markets.

Chen & Wu (2007) suggested that core competences should be unique, have special features, be difficult to imitate and have rather high competitiveness in resource deployment or skills. The effectiveness that could be generated from core competences consists from an enterprise being able to enter into a broad and changeable market, bring meaningful contributions to the value of customers, be difficult for competitors to imitate, and being able to maintain competitive superiority (Gilgeous & Parveen, 2001).

In summary of the above, the definition of core competences in this article referred to the effective and efficient team capabilities demonstrated by graduates in an enterprise's organization that are commonly possessed by employees after they enter into an information technology firm. The graduates can provide the employers with favourable competitiveness and have good adaptability to the environment, as well as capabilities in communication and coordination, teamwork and cooperation, customer orientation, problem analysis and solving, the pursuit of excellent innovation, and adaptation to organizational changes.

The curriculum to upgrade student employability

As of March of 2010, there were 23 universities of technology implementing curricula for student employment in Taiwan, with a total of 72 learning programmes or subjects, as shown in table 1.

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Table 1. Summary of the types of curriculum for student employment implemented during 2007 - 2010

Type of curriculum for student employment	*Independence*	*Function*	*Subordinacy*
• Lectures of Enterprises' Practical Operations	◎	◎	
• Employment-Specific units		◎	◎
• Industry and Academia Cooperative Curricula	◎	◎	
• Curricula for The Final-Mile To Employment	◎	◎	
• Industry and Academia Joint Classes	◎		
• Workplace Experience (such as visits to enterprises, practical training in enterprises)	◎	◎	

METHODOLOGY

Behavioural Event Interview Method (Bei)

The KSAOs (Knowledge, Skills, Attitude, Others) competence profile was established via literature analysis and discussions with experts and was applied to interviews of competences in batches over 12 months. The BEI method was adopted for the interviews of 54 administrators from 31 small and medium information enterprises for the purpose of establishing the draft core competences and the survey questionnaire for information personnel at the organizational level.

The establishment of the competence profile was generated via task analysis. The results of the task analysis included the knowledge, skills, capabilities and other specialties needed for the execution of a task, also called KSAOs (Desimone, Werner & Harris, 2002; Noe, 2005. A total of 250 core competences were obtained. The BEI method was used to collect STAR (situation, task, action, and result) specific behavioural events, which were (Desimone, Werner, & Harris, 2002):

Situation: the status of the event;

Task: the goal generated in response to the need for the situation;

Action: the proceedings adopted by the person in charge;

Result: the consequences of the proceedings.

Expert Interviews

The items for the interviews of the administrators included the name of the competence, behavioural features, the performance weighting, the difficulty, the importance, the frequency, and the improvement via training, the improvement via recruiting, the necessity for certificates, and the handling of differences in competence. The items were graded according to the level of application by the employees, and the scores were: NA (not applicable), 1 (rarely applied), 2 (occasionally applied), 3 (a medium level of application), 4 (often applied), and 5 (extremely important).

Surveys

Purposive sampling was adopted to send questionnaires through the Internet to the top 1,000 large information enterprises in Taiwan as the subjects for the purpose of confirming core

competences. Cronbach's α was adopted for the reliability test to examine the internal consistency of the answers from 42 subjects that received a pre-test. The validity test was conducted using three human resource experts, 15 industry experts, and eight experts from academia to analyse the validity of the contents. Next, Bartlett's Sphericity Test was conducted to confirm whether each aspect was near the normal multivariate and was therefore suitable to conduct factor analysis, and the Kaiser-Meyer-Olkin measure of sampling adequacy was used to conduct the factor validity test. Finally, principal components analysis was adopted and the maximum variance for oblique rotation was used.

RESULTS

Six Core Competences

The survey recovered 1,002 valid samples, of which the majority were male (676 samples; 67.5%). Of the samples, 363 (36.25%) had worked between five and 10 years, which was the majority, followed by three to five years (313 samples; 31.24%). Most of the samples were involved in technical work (576 samples; 57.5%), followed by administrative work (175 samples; 17.5%) and business work (88 samples; 8.75%).

The reliability Cronbach's α of the questionnaire was 0.832, indicating that the performance between all aspects of the overall questionnaire had reached an excellent level. The KMO (0.723) reached a medium level (KMO>0.7), indicating that the validity of the questionnaire possessed a stable effect. The result of Bartlett's Sphericity Test also showed the appropriateness to conduct factor analysis. The Principal Components Analysis method was adopted for factor analysis, using oblique rotation to extract factors. A total of 17 items and six factors were extracted, which allowed the interpretation capability to reach 72.9% for specific measurements of the core competences. This study obtained six core competences for the cultivation of students: customer orientation, problem analysis and solving, the pursuit of excellent innovation, communication and coordination, teamwork and cooperation, and adaptation to organizational changes. Among them, the given value for the pursuit of excellent innovation was the highest, indicating that it was the most important.

Six Types of Curricula for Student Employment

During 2007 to 2010, the curricula for student employment used by universities of technology that were helpful for upgrading the students' professions included Internet management, software development, databank management, and e-enterprises.

Table 2. Statistics of the number of curricula for student employment in universities of technology during 2007 to 2010

Type of Curriculum	*North*	*Central*	*South*	*Off-shore Island*	*Total*	*Ratio*
Internet Management	3	5	7	0	15	20.83%
Software Development	7	5	2	1	15	20.83%
Databank Management	3	1	1	0	5	6.95%
E-Enterprise	3	11	6	0	20	27.78%
Enterprise Experience	10	4	3	0	17	23.61%
Total	26	26	19	1	72	100%

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Building the Quality Improvement Approach Using GRA

The experts included one human resource consultant, one professional community scholar, and six high level information administrators. The grey relational coefficient method proposed by Teng (2003) was adopted for GRA. The grey relation means the correlation of uncertainties between issues, which can be calculated to obtain a series of grey relational grades for each factor, in which the grey relational grade represents the proximity between each factor and the major behaviour, as shown in figure 1.

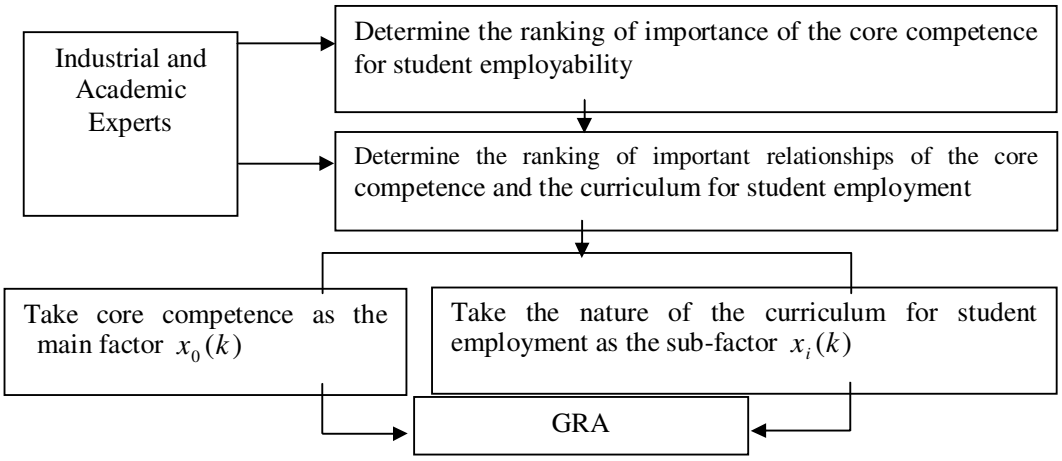

Figure 1. Chart for building a quality improvement approach using GRA

The GRA between the Types of Curriculum for Students' Employment and the Pursuit of Excellent Innovation

The importance of the core competences obtained through experts: The experts answered each item of the core competences to obtain the ranking of the importance of the core competences from high to low, as shown in Table 3.

Table 3. Ranking of the importance of the core competences for graduates' employability

	Expert Item	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*
Core Competence	Pursuit of Excellent Innovation	2	3	2	2	1	6	3	2
	Customer Orientation	6	6	1	4	2	5	4	5
	Communication and Coordination	3	5	5	6	6	4	2	4
	Adaptation to Organizational Changes	1	1	3	3	3	1	5	1
	Problem Analysis and Solving	4	4	4	5	5	3	1	6
	Teamwork and Cooperation	5	2	6	1	4	2	6	3

Note: A score of 6 represents the most important; 1 represents the least important

The ranking of the correlation between curriculum and core competence: The high to low correlations between the core competences and the curricula for student employment (as answered by the experts) are shown in Table 4.

Table 4. Ranking of the correlations between the core competences and the curricula for student employment

	Expert	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*
Type of curriculum for student employment	Lectures of Enterprises' Practical Operations	6	3	4	1	2	6	4	3
	Employment Curricula	1	2	2	3	1	4	6	4
	Industry and Academia Cooperative Curricula	3	5	6	5	3	2	3	5
	Curricula for the Final-Mile to Employment	2	1	3	4	6	1	1	1
	Industry and Academia Joint Classes	4	4	5	2	4	3	5	6
	Workplace Experience	5	6	1	6	5	5	2	2

The GRA between the type of curriculum and the pursuit of excellent innovation, taking core competence as the main factor $x_0(k)$ and the type of curriculum $x_i(k)$ as the sub-factor

(1) Since the original data had satisfactory comparability, the pursuit of excellent innovation $x_{01}(k)$ was taken as the reference sequence, while each type of employment specific curriculum was taken as the comparative sequence to conduct GRA.

(2) The equation $\Delta_{0i}(k) = | \chi_0(k) - \chi_i(k) |$ was used to obtain the value of difference sequences. The results were as follows:

$\Delta_{01} = (4.0 \quad 0.0 \quad 2.0 \quad 1.0 \quad 1.0 \quad 0.0 \quad 1.0 \quad 1.0)$ $\Delta_{02} = (1.0 \quad 1.0 \quad 0.0 \quad 1.0 \quad 0.0 \quad 2.0 \quad 3.0 \quad 2.0)$

$\Delta_{03} = (1.0 \quad 2.0 \quad 4.0 \quad 3.0 \quad 2.0 \quad 4.0 \quad 0.0 \quad 3.0)$ $\Delta_{04} = (0.0 \quad 2.0 \quad 1.0 \quad 2.0 \quad 5.0 \quad 5.0 \quad 2.0 \quad 1.0)$

$\Delta_{05} = (2.0 \quad 1.0 \quad 3.0 \quad 0.0 \quad 3.0 \quad 3.0 \quad 2.0 \quad 4.0)$ $\Delta_{06} = (3.0 \quad 3.0 \quad 1.0 \quad 4.0 \quad 4.0 \quad 1.0 \quad 1.0 \quad 0.0)$

(3) The equation was applied to obtain the maximum and minimum values. The maximum value was 5.0, and the minimum value was 0.0.

(4) Let the identification coefficient $\zeta = 0.5$

(5) The grey relational coefficient was calculated using: $\gamma(\chi_i(k), \chi_j(k)) =$
$(\Delta\min + \zeta\Delta\max)/(\Delta_{ij}(k) + \zeta\Delta\max)$

(6) The grey relational grade was calculated based on an equal weight $(\beta = 1/8)$ to obtain:
$\gamma(\chi_0, \chi_1) = 0.7247$, $\gamma(\chi_0, \chi_2) = 0.7136$, $\gamma(\chi_0, \chi_3) = 0.5630$, $\gamma(\chi_0, \chi_4) = 0.5952$,
$\gamma(\chi_0, \chi_5) = 0.5717$, $\gamma(\chi_0, \chi_6) = 0.6026$

(7) The ranking of the grey relational grade:

$\gamma(\chi_0, \chi_1) = 0.7247 > \gamma(\chi_0, \chi_2) = 0.7136 > \gamma(\chi_0, \chi_6) = 0.6026 > \gamma(\chi_0, \chi_4) = 0.5952 > \gamma(\chi_0, \chi_5) = 0.5717 > \gamma(\chi_0, \chi_3) = 0.5630$

The results were translated into percentages, as shown in Table 5.

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Table 5. The ranking of grey relational grade (ζ= 0.5) for the pursuit of excellent innovation and the six types of curriculum

Type of curriculum for students' employment	*Value of Grey Relational Grade* $r(x_0, x_i)(\%)$	*Ranking*
Lectures of Enterprises' Practical Operations	72.47	1
Employment Curricula	71.36	2
Industry and Academia Cooperative Curricula	56.30	6
Curricula for the Final-Mile to Employment	59.52	4
Industry and Academia Joint Classes	57.17	5
Workplace Experience	60.26	3

In summary of the above, the GRA results for the core competences and the curricula for student employment were compiled as shown in Table 6.

Table 6. GRA Results

	Pursuit of Excellent Innovation	*Customer Orientation (Ranking %)*	*Communication & Coordination (Ranking %)*	*Adaptation to Organizational Changes*	*Problem Analysis & Solving*	*Teamwork & Cooperation*
Lectures of Enterprises' Practical Operations	1 (100%)	2 (83.33%)	6 (16.67%)	5 (33.33%)	5 (33.33%)	2 (83.33%)
Employment Curricula	2 (83.33%)	4 (50.00%)	5 (33.33%)	2 (83.33%)	6 (16.67%)	4 (50.00%)
Industry & Academia Cooperative Curricula	6(16.67%)	3(66.67%)	1(100%)	4(50.00%)	2(83.33%)	3(66.67%)
Curricula for the Final-Mile to Employment	4 (50.00%)	6 (16.67%)	4 (50.00%)	1 (100%)	4 (50.00%)	6 (16.67%)
Industry & Academia Joint Classes	5 (33.33%)	5 (33.33%)	3 (66.67%)	3 (66.67%)	1 (100%)	1 (100%)
Workplace Experience	3 (66.67%)	1 (100%)	2 (83.33%)	6 (16.67%)	3 (66.67%)	5 (33.33%)

DISCUSSION

Three conditions for the correlation between core competences and curricula:

1. Horizontal one-dimensional correlations: representing the existence of differences for high, medium, low or no correlation between core competences and curricula
2. Vertical two-dimensional random packing relationships: representing how excessively deep or excessively shallow curriculum planning will not cultivate the anticipated core competences.
3. Three-dimensional cause and effect relationships: considering the time factors where curricula are the causes and core competences are the effects, in order to explore the status of core competences achieved by the curricula.

This research focused on horizontal one-dimensional correlations to find the types of programmes that should be established for the curricula to enhance certain core competences for students.

This research adopted GRA in connection with the opinions of experts to combine the benefits of both qualitative and quantitative research, not only for systematic relational analysis but also for building the approach (Teng, 2003). Through relational analysis, numerous factors within a system may be extracted according to the level of effect each factor has on the system, such as the major and minor factors, the significant factors, factors which have the potential to be developed, and factors which should be disregarded. The traditional statistical regression analysis method requires a large volume of data and there are limitations on the functional relationship. GRA, which requires less data and has special features for multiple factor analysis, can well compensate for the disadvantage of statistical regression analysis. Therefore, it was appropriate to adopt GRA.

This research established a quality improvement approach through the correlation analysis between core competences and curricula from the analysis of information enterprises' core competences, as shown in Figure 2.

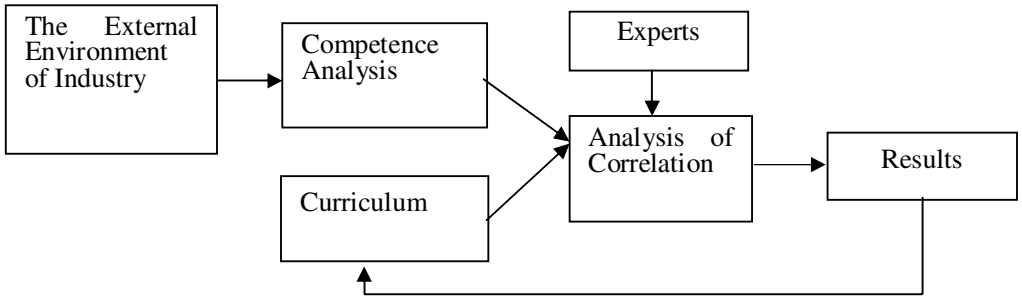

Figure 2. Quality Improvement Approach of Competence and Curriculum

The research results were consistent with the concepts of Brennan's (2004) research, which first built the graduating student profile and established the core competencies the students should have, before creating the initial design of the curriculum. In the approach, the competences and curriculum were modified using feedback from continuous correlation analysis, which was consistent with the logic of Burchell's (2000) action research method of continuously examining and revising the differences between schools' competency-based education and hospitals' practical education. The issue of core competence can be seen as an example of the application of this approach.

The GRA results showed that each of the curricula for student employment could foster students' core competences as follows:

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1. When the purpose of the curriculum was to foster the competence for the pursuit of excellent innovation, the preferred three items were lectures of enterprises' practical operations, employment curricula, and workplace experience.
2. When the purpose of the curriculum was to foster the competence for customer orientation, the preferred three items were workplace experience, lectures of enterprises' practical operations, and industry and academia cooperative curricula.
3. When the purpose of the curriculum was to foster the competence for communication and coordination, the preferred three items were industry and academia cooperative curricula, workplace experience, and industry and academia joint classes.
4. When the purpose of the curriculum was to foster the competence for adaptation to organizational changes, the preferred three items were curricula for the Final-Mile to employment, employment curricula, and industry and academia joint classes.
5. When the purpose of the curriculum was to foster the competence for problem analysis and solving, the preferred three items were industry and academia joint classes, industry and academia cooperative curricula, and workplace experience.
6. When the purpose of the curriculum was to foster the competence for teamwork and cooperation, the preferred three items were industry and academia joint classes, lectures of enterprises' practical operations, and industry and academia cooperative curricula.

CONCLUSION

There are always some ambiguities between core competences and the cultivation of a curriculum; therefore, it is worth recommending the GRA approach to find their correlations. The KSAO competence profile and the BEI method were adopted to obtain the core competences. Since it was inevitable that the interviewees would be too subjective in describing their opinions, this study coordinated discussions with experts and full considerations of their opinions to dissociate the appropriate core competences. According to the competency-based point of view and the results of this research, it was found that core competences at the organizational level are indeed required for workers in the professional field of information management to carry out their tasks. However, there are many gaps that need to be filled, in regards to the transition from the requirements of core competences to the development of core competences. For example, how to verify that a planned curriculum can reach the anticipated cultivation of core competences is an issue of concern by curriculum developers.

It is also worth paying attention to whether a cause and effect relationship exists between competences and curricula. If the curriculum is the cause and core competence is the effect, then how far does the curriculum affect the formation of core competence? This study did not conduct an in-depth exploration of the cause and effect relationship due to research limitations. However, this research rationalized the core competences for different purposes and created a ranking of the optimum curriculum types from the correlation between current curricula for student employment and core competences. This provided a more definitive clarification of the correlation between competences and curricula and could be used as an important reference. The correlation analysis approach could be used by information management-related departments at technological universities in order to review the appropriateness of their curricula for student employment. It could also be used by the curriculum departments in universities of technology to find the most effective competency-based curriculum.

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