Professional competences training path for an e-commerce major, based on the ISM method

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ABSTRACT: The determination of the training path for professional competences has an important influence on the training of students majoring in e-commerce. The factors affecting the professional competences required by e-commerce were determined on the basis of skill requirements for e-commerce positions in industry. The hierarchical relationships among the factors were analysed using interpretive structural model (ISM). It was concluded that there were two paths to train the professional competences of e-commerce students. One is through training technical ability; the other is through training business ability. Finally, basic and critical skills were identified for each path, and the skills training sequences for each path were determined.

INTRODUCTION

E-commerce has developed rapidly in recent years. In the 13th five-year strategic plan for China, e-commerce has been identified as a focus for development and, hence, provides a good prospect for the employment of e-commerce majors. Many universities in China have set up e-commerce majors and a large number of graduates have been trained. However, there is a problem. On the one hand, it is difficult for enterprises to recruit the e-commerce graduate that can meet their requirements and, on the other hand, a large number of e-commerce graduates cannot find a job related to their major. The reason is that the professional competence of e-commerce graduates is weak and does not meet the requirements of the enterprise [1-3]. Therefore, promoting the professional competence of e-commerce students is important to improve students' employability.

The key to enhancing the professional competence of e-commerce students is to determine the professional competence training path of the e-commerce major. At present, research on the cultivation of e-commerce students' professional competence is mostly from the perspective of curriculum teaching. There is very little about its applicability to the e-commerce industry. This has led to a gap between the professional training of e-commerce in universities and the requirements of enterprises. The factors that affect the professional competence of e-commerce students are presented in this article and the relationships among these factors are analysed. The professional competence training paths of the e-commerce students are determined on the basis of these relationships.

PROFESSIONAL COMPETENCES FOR E-COMMERCE

E-commerce is multi-disciplinary and graduates' employability is relatively broad. According to the surveys of Deng et al [4] and Yin and Tao [5], e-commerce positions in enterprises are divided into technical and business positions. Consequently, the professional competences of e-commerce students can be divided into technical and business competences. Job recruitment information about technical and business e-commerce positions was selected from recruitment Web sites. Skills requirements that feature in more than 40% of the positions were extracted to identify the core skills of technical positions and business positions. The skills requirements are shown in Table 1.

Table 1: The skills requirements of e-commerce positions.

Position type	Skills requirements of the position	Frequency	Percentage
Technical	Master one or more programming languages	463	88.9
	Familiar with Web design tools and Web programming	351	67.4
	Familiar with database design theory and methods	319	61.2
	Master one or more database software systems	437	83.9

	Good systems analysis and design	308	59.1
	Familiar with systems analysis tools	269	51.6
	Familiar with basic network protocols	302	58.0
Business	Familiar with on-line survey methods	207	47.4
	Master data mining tools	255	58.4
	Familiar with data analysis methods	237	54.2
	Good copywriting skills	321	73.4
	Familiar with Web site promotional methods	304	69.6
	Familiar with the main on-line marketing methods	367	84.0
	Master SEO methods	277	63.4
	Good communication ability	391	89.5
	Good team work ability	378	86.5

By analysing the core skills of the technical and business positions in Table 1, the critical professional competences of e-commerce students can be determined. These factors are shown in Table 2.

Table 2: Professional competence of e-commerce students.

	Dimensions	Factors
Professional competences of e-commerce (C_1)	Technical ability (C_2)	Programming skills (C_4)
		Database design skills (C_5)
		System analysis and design skills (C_6)
		Web design and development skills (C_7)
		Protocol analysis skills (C_8)
	Business ability (C_3)	On-line survey skills (C_9)
		Data mining and data analysis skills (C_{10})
		Copywriting skills (C_{11})
		On-line marketing skills (C_{12})
		Web site promotion skills (C_{13})
		Communication skills (C_{14})
		Team work skills (C_{15})

ANALYSIS OF THE INTERACTIONS AMONG THE COMPETENCES

Table 2 shows that there are many professional competences of e-commerce. Moreover, there may be interactions among these competences. Therefore, before studying the professional competence training path for e-commerce students, it is necessary to determine the interactions among these competences. The interactions are analysed through the interpretive structural model (ISM). The ISM is a method applied in analysing the hierarchical structure of a system and the hierarchical relationships among the elements of the system. The main idea of ISM is that an adjacency matrix is used to determine direct or indirect interactions among the elements of the system and, then, the hierarchical relationships among the elements are analysed [6]. The ISM process is as follows:

The Adjacency Matrix

Ten employees working in e-commerce positions and 15 teachers engaged in an e-commerce major were invited as experts to analyse the interactions among the factors in Table 2.

$$A = [a_{ij}]_{15\times15} = \begin{bmatrix} 0&0&0&0&0&0&0&0&0&0&0&0&0&0&0 \\ 1&0&0&0&0&0&0&0&0&0&0&0&0&0&0 \\ 1&0&0&0&0&0&0&0&0&0&0&0&0&0&0 \\ 0&0&0&0&0&1&1&1&0&1&0&0&0&0&0 \\ 0&0&0&0&0&1&1&0&0&0&0&0&0&0&0 \\ 0&1&0&0&0&0&0&0&0&0&0&0&0&0&0 \\ 0&1&0&0&0&1&0&0&0&0&0&0&0&0&0 \\ 0&0&0&0&0&0&1&0&0&0&0&0&0&0&0 \\ 0&0&1&0&0&0&0&0&0&0&0&0&0&0&0 \\ 0&0&0&0&0&0&0&0&1&0&0&0&0&0&0 \\ 0&0&1&0&0&0&0&0&0&0&0&0&0&0&0 \\ 0&0&1&0&0&0&0&0&0&0&0&0&0&0&0 \\ 0&0&1&0&0&0&0&0&0&0&0&1&0&0&0 \\ 0&0&0&0&0&0&0&0&0&0&0&1&0&0&1 \\ 0&0&0&0&0&0&0&0&0&0&0&1&0&0&0 \end{bmatrix}$$

Then, the adjacency matrix A of factors affecting the professional competence of e-commerce students were established, viz.

In matrix A, a_{ij} expresses the interactions between C_i and C_j. If $a_{ij}=1$ and $i \neq j$, then C_i has a direct effect on C_j. If $a_{ij}=0$ and $i \neq j$, C_i has no direct effect on C_j.

The Calculation of the Reachable Matrix

On the basis of the adjacency matrix A, reachable matrix of A that is expressed by symbol M can be calculated by Boolean operations. The rules of Boolean operations are shown elsewhere [7], hence, the reachable matrix M can be calculated as follows.

If $M=(A+I)^n=(A+I)^{n+1}$ and $M \neq (A+I)^{n-1}$ have been established, then, M can be judged as the reachable matrix, where, I is unit matrix. According to above calculation process, M can be obtained as:

$$M = \begin{bmatrix}
1&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
1&1&0&0&0&0&0&0&0&0&0&0&0&0&0\\
1&0&1&0&0&0&0&0&0&0&0&0&0&0&0\\
1&1&1&1&0&1&1&1&1&1&0&1&1&0&0\\
1&1&0&0&1&1&1&0&0&0&0&0&0&0&0\\
1&1&0&0&0&1&0&0&0&0&0&0&0&0&0\\
1&1&0&0&0&1&1&0&0&0&0&0&0&0&0\\
1&1&0&0&0&1&1&1&0&0&0&0&0&0&0\\
1&0&1&0&0&0&0&0&1&0&0&0&0&0&0\\
1&0&1&0&0&0&0&0&1&1&0&0&0&0&0\\
1&0&1&0&0&0&0&0&0&0&1&0&0&0&0\\
1&0&1&0&0&0&0&0&0&0&0&1&0&0&0\\
1&0&1&0&0&0&0&0&0&0&0&1&1&0&0\\
1&0&1&0&0&0&0&0&0&0&0&1&0&1&1\\
1&0&1&0&0&0&0&0&0&0&0&1&0&0&1
\end{bmatrix}$$

Partition of the Hierarchical Structure of Matrix M0

$R(C_i)$ is a reachable set-combination of all column elements equal to 1 in row C_i. $A(C_i)$ is a advanced set-combination of all row elements equal to 1 in column C_i. Hence, the reachable set and advanced set of every element in matrix M can be obtained. The results are shown in Table 3.

Table 3: Reachable set and advanced set in matrix M.

	$R(C_i)$	$A(C_i)$	$R(C_i) \cap A(C_i)$
C_1	C_1	C_1,C_2,C_3,C_4,C_5,C_6,C_7,C_8,C_9,C_{10},C_{11}, C_{12},C_{13},C_{14},C_{15}	C_1
C_2	C_1, C_2	C_2, C_4 ,C_5, C_6, C_7, C_8	C_2
C_3	C_1, C_3	C_3, C_4, C_9, C_{10}, C_{11}, C_{12}, C_{13}, C_{14}, C_{15}	C_3
C_4	C_1,C_2,C_3,C_4,C_6,C_7,C_8,C_9,C_{10},C_{12},C_{13}	C_4	C_4
C_5	C_1, C_2, C_5, C_6, C_7	C_5	C_5
C_6	C_1, C_2, C_6	C_4, C_5, C_6, C_7, C_8	C_6
C_7	C_1, C_2, C_6, C_7	C_4, C_5, C_7, C_8	C_7
C_8	C_1, C_2, C_6, C_7, C_8	C_4, C_8	C_8
C_9	C_1, C_3, C_9	C_4, C_9, C_{10}	C_9
C_{10}	C_1, C_3 ,C_9, C_{10}, C_{12}, C_{13}	C_4,C_{10}	C_{10}
C_{11}	C_1, C_3, C_{11}	C_{11}	C_{11}
C_{12}	C_1, C_3, C_{12},	C_4, C_{10} ,C_{12}, C_{13}, C_{14}, C_{15}	C_{12}
C_{13}	C_1, C_3, C_{12}, C_{13}	C_4, C_{10}, C_{13}	C_{13}
C_{14}	C_1, C_3, C_{12}, C_{14}, C_{15}	C_{14}	C_{14}
C_{15}	C_1, C_3, C_{12}, C_{15}	C_{14}, C_{15}	C_{15}

According to $R(C_i) \cap A(C_j) = R(C_i)$, the highest-level element set expressed by symbol L_1 can be obtained. Thus, L_1= {C_1}. After the row and column of C_1 are eliminated from matrix M, the matrix M' is obtained. As for matrix M,

the reachable set and advanced set of every element in matrix M' also can be obtained. The results are shown in Table 4.

Table 4: Reachable set and advanced set for matrix *M'*.

	$R(C_i)$	$A(C_j)$	$R(C_i) \cap A(C_j)$
C_2	C_2	C_2, C_4 ,C_5, C_6, C_7, C_8	C_2
C_3	C_3	C_3, C_4, C_9, C_{10}, C_{11}, C_{12}, C_{13}, C_{14}, C_{15}	C_3
C_4	C_2,C_3,C_4,C_6,C_7,C_8,C_9,C_{10},C_{12},C_{13}	C_4	C_4
C_5	C_2, C_5, C_6, C_7	C_5	C_5
C_6	C_2, C_6	C_4, C_5, C_6, C_7, C_8	C_6
C_7	C_2, C_6, C_7	C_4, C_5, C_7, C_8	C_7
C_8	C_2, C_6, C_7, C_8	C_4, C_8	C_8
C_9	C_3, C_9	C_4, C_9, C_{10}	C_9
C_{10}	C_3 ,C_9, C_{10}, C_{12}, C_{13}	C_4,C_{10}	C_{10}
C_{11}	C_3, C_{11}	C_{11}	C_{11}
C_{12}	C_3, C_{12},	C_4, C_{10} ,C_{12}, C_{13}, C_{14}, C_{15}	C_{12}
C_{13}	C_3, C_{12}, C_{13}	C_4, C_{10}, C_{13}	C_{13}
C_{14}	C_3, C_{12}, C_{14}, C_{15}	C_{14}	C_{14}
C_{15}	C_3, C_{12}, C_{15}	C_{14}, C_{15}	C_{15}

Hence, using $R(C_i) \cap A(C_j) = R(C_i)$, the second-level set expressed by symbol L_2 can be obtained as L_2= {C_2, C_3}. Continuing the process yields L_3={C_6, C_9 , C_{11}, C_{12}}; L_4={C_7, C_{13}, C_{15}}; L_5={C_5, C_8, C_{10}, C_{14}}; and L_6={C_1}.

PROFESSIONAL COMPETENCES TRAINING PATH FOR E-COMMERCE

According to the elements L_1, L_2, L_3, L_4, L_5, L_6 and the data in the adjacency matrix A, the professional competences training path for e-commerce can be determined. The path is shown in Figure 1.

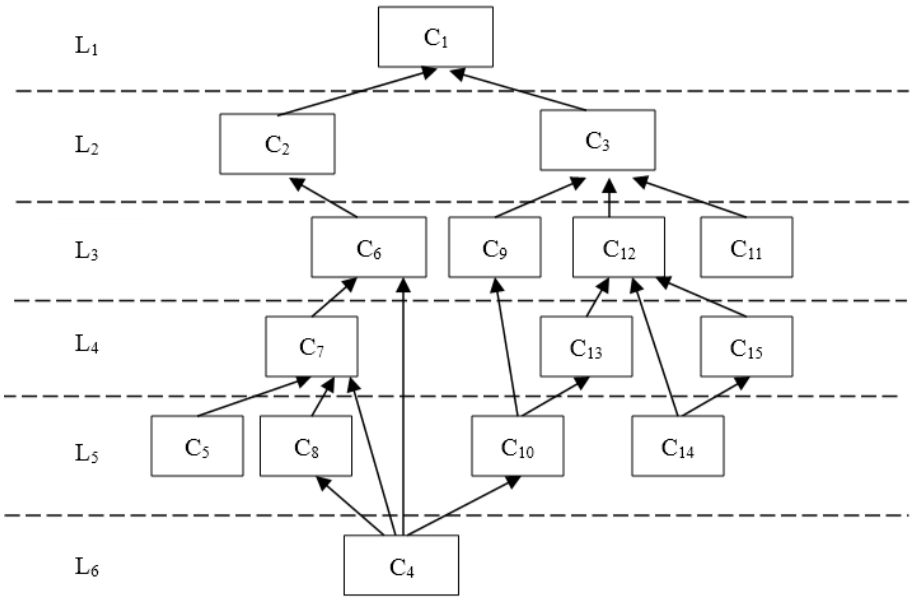

Figure 1: Professional competences training path for e-commerce.

CONCLUSIONS

From Figure 1, the following conclusions can be drawn:

- There are two paths by which to train the professional competences of e-commerce students, viz. by training the technical ability or by training the business ability. Therefore, in the professional training of e-commerce students, universities can choose one path or the other according to the characteristics of the university, e.g. universities in

science and engineering can focus on training technical ability; universities in economics and management can focus on training business ability.

- For the technical training path, C_4 and C_5 are basic skills because C_4 and C_5 have direct or indirect impacts on other factors on this path, but other factors do not affect C_4 and C_5. Meanwhile, C_6, C_7 and C_8 are critical skills. because these skills play a linking role between preceding and following skills. The students' technical ability should be trained in the following sequence: C_4-> (C_5, C_8)-> C_7-> C_6-> C_2 .

- For the business training path, C_4, C_{11} and C_{14} are basic skills, and C_9, C_{10}, C_{12}, C_{13} and C_{15} are critical skills. The students' business ability should be trained by the sequence C_4-> (C_{10}, C_{14})-> (C_{13}, C_{15})-> (C_9, C_{12}, C_{11})-> C_3.

- In the professional competence training for e-commerce, whether it is the technical ability training path or the business ability training path, C_4 is a basic skill for each. Therefore, for students in an e-commerce major, C_4 is the basic skill, which must be mastered.

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