Study on the Design of Situated Learning Oriented Enterprise E-learning Training Course

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Abstract: E-learning training mode has been paid more and more attention. This study proposes the situation oriented E-learning training process in order to strengthen the training process, and using FUZZY-ISM method to improve the shortage witch adjacency matrix of ISM is binary judgment, it is easy to cause the deviation of evaluation result caused by subjectivity. It sets up a set of quantitative and objective methods.

1. Introduction

Training is the process and means of management, which can achieve the consciousness, initiative and creativity of the employees. Nowadays, training courses gradually change from traditional teaching method to E-learning mode. Due to the low cost, wide application, high consistence, low restriction and high quality control, E-learning training mode has been paid more and more attention.

However, scholars have put forward various oriented training courses in order to improve training effect in the design of training course. For example, Ke et al (2008) [1] put forward performance-oriented. Su & Cheng (2017) [2] put forward goal orientation. Liu & Zou (2018) [3] put forward strategy orientation. It can be seen that researches in the past focus on post training result but ignore the effect control in the training process. This study proposes the situation oriented E-learning training process in order to strengthen the training process. The situation oriented application creates and constructs real learning environment for the trainees and enables the trainees to grasp and learn the relevant knowledge in the specific environment. Situational orientation can provide good hints or enlightenment for the trainees and cultivate the adaptability of the trainees.

Most of the researches on the design of training courses in the past are qualitative methods [4-6]. However, due to complexity of the factors affecting the training courses, scholars begin to use systemic analysis method ISM for the design of training course. For example, Lin (2011) [7] uses ISM in the design of university curriculum. Tan et al (2018) [8] apply ISM in the design of network course for college students.

However, because the adjacency matrix of ISM is binary judgment, it is easy to cause the deviation of evaluation result caused by subjectivity. The frequently-used mean method cannot be used for the gathering of expert opinions. FUZZZY-ISM can solve the non-zero or one selection {0,1} of the Crisp Set, expands it to any selection between 0 and 1 and gives the numerical value between 0 and 1 according to different evaluation level. Therefore, this study puts forward the FUZZY-ISM method, applies it to the design of situational oriented enterprise E-learning training courses and sets up a set of quantitative and objective methods.

2. Method

In this study, the triangular fuzzy number is used to divide the impact of attribute into 5 grades: “No influence”; “Slight influence”; “Middle influence”; “Larger influence” and “Strong influence”, which can be expressed as l_1, l_2, l_3, l_4, l_5 , therefore, the linguistic function can be expressed as: $F(l_i)=\tilde{\imath}$, i =0, 0.25, 0.5, 0.75, 1 in which $\tilde{\imath}$ is a fuzzy number.

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If the assessment is made by experts, the following methods can be used to integrate the multiple decisions making result:

$$\begin{cases} A_{ij} = min\{e_{ijp}\} \\ B_{ij} = \left\{\prod_{p=1}^{n} e_{ijp}\right\}^{1/p} \\ C_{ij} = max\{e_{ijp}\} \end{cases} \quad (1)$$

e_{ijp} is ordered to be the valuation matrix, being used to express the decision value of attribute in item *i* and *j* of digit *p*. The integrated fuzzy number is ordered to be $\widetilde{A_{ij}} = (A_{ij}, B_{ij}, C_{ij})$, then, defuzzify by using the graded mean method to calculate the property average (PA) to be real number. Formula is as shown as formula (2):

$$PA_{ij} = \frac{(A_{ij}+4B_{ij}+C_{ij})}{6} \quad (2)$$

At last, compare each property average with the central fuzzy number 0.5, which >central fuzzy number as 1, and <central fuzzy number as 0. Finally, the results can be converted into the adjacency matrix.

3. Case Study

3.1 Establishment of Situated Learning Oriented E-Learning Training Course Design Component.

Based on the relevant studies in the past, the 11 situated learning oriented E-learning training course design components in the research are as follow Table 1.

Table 1 11 situated learning oriented E-learning training course design components

Code	Components
S1	Course objective
S2	Course content
S3	Curriculum strategy
S4	Course evaluation
S5	Cognitive support
S6	Learning activities
S7	Information expression
S8	Learning needs analysis
S9	Situated learning carrier selection
S10	Situated learning model selection
S11	Situated learning implementation method

3.2 Questionnaire Design and Survey.

FUZZY-ISM questionnaire design uses five level for determination of the influence among two components. It selects the 12 enterprises in Xiamen, visits the 12 supervisors of enterprise training, 5 human resource management teachers in university and evaluates the influence of 11 situated learning orientation on enterprise E-learning training course design components.

4. Analysis

4.1 Reachable Matrix Calculation.

Experts' review opinions gathered in the questionnaire are changed into triangle fuzzy number through the method in Table 1. The fuzzy paired comparison matrix is established and experts' review result is gathered in Formula (1) as Fig.1:

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11
S1	0	(0.5,0.83,1)	(0.25,0.41,0.5)	(0.5,0.81,0.75)	(0.25,0.48,0.5)	(0.25,0.33,0.5)	(0,0.23,0.25)	(0.0.32,0.5)	(0.25,0.26,0.5)	(0.25,0.42,0.75)	(0,0.16,0.25)
S2	(0,0.24,0.25)	0	(0, 0.38, 0.25)	(0,0.47,0.5)	(0,0.16,0.25)	(0,0.32,0.5)	(0.5,0.88,0.75)	(0,0.23,0.25)	(0.25,0.33,0.5)	(0.25,0.11,0.5)	(0,0.17,0.5)
S3	(0.25,0.31,0.5)	(0.75,0.875,1)	0	(0.25,0.33,0.5)	(0.5,0.51,0.75)	(0.25,0.35,0.75)	(0,0.32,0.5)	(0,0.16,0.25)	(0.25,0.48,0.5)	(0.5,0.52,1)	(0.5,0.57,0.75)
S4	(0.25,0.26,0.5)	(0.25,0.34,0.5)	(0,0.25,0.5)	0	(0.25,0.41,0.5)	(0.25,0.50,0.75)	(0,0.08,0.25)	(0.25,0.11,0.5)	(0,0.16,0.25)	(0,0.02,0.5)	(0,0.16,0.25)
S5	(0.25,0.48,0.5)	(0,0.33,0.5)	(0,0.17,0.5)	(0.25,0.26,0.5)	0	(0.5,0.75,1)	(0.5,0.54,0.75)	(0.25,0.41,0.5)	(0.25,0.26,0.5)	(0.25,0.33,0.5)	(0,0.23,0.25)
S6	(0.0.33,0.5)	(0.25,0.34,0.5)	(0.25,0.11,0.5)	(0.25,0.49,0.5)	(0.25,0.41,0.5)	0	(0,0.23,0.25)	(0,0.38,0.25)	(0,0.08,0.25)	(0.25,0.35,0.75)	(0.25,0.33,0.5)
S7	(0,0.16,0.25)	(0,0.46,0.75)	(0,0.16,0.25)	(0.25,0.44,0.5)	(0,0.23,0.25)	(0,0.16,0.25)	0	(0,0.02,0.5)	(0,0.16,0.25)	(0,0.25,0.5)	(0.25,0.31,0.5)
S8	(0.75,0.84,1)	(0.25,0.53,0.75)	(0.5,0.6,1)	(0,0.17,0.5)	(0.5,0.45,1)	(0,0.38,0.25)	(0,0.02,0.5)	0	(0.5,0.52,1)	(0.5,0.82,1)	(0.25,0.26,0.5)
S9	(0.5,0.53,1)	(0.25,0.31,0.5)	(0.25,0.26,0.5)	(0, 0.38, 0.25)	(0.25,0.11,0.5)	(0.75,0.87,1)	(0.25,0.42,0.75)	(0,0.23,0.25)	0	(0.25,0.41,0.5)	(0.25,0.33,0.5)
S10	(0,0.25,0.5)	(0.75,0.88,1)	(0.25,0.26,0.5)	(0.25,0.48,0.5)	(0,0.02,0.5)	(0.25,0.53,0.75)	(0,0.11,0.25)	(0,0.22,0.5)	(0.25,0.42,0.75)	0	(0.5,0.57,0.75)
S11	(0,0.29,0.5)	(0.25,0.47,0.5)	(0.25,0.38,0.5)	(0,0.23,0.25)	(0,0.02,0.5)	(0,0.11,0.25)	(0.25,0.47,0.5)	(0,0.17,0.25)	(0,0.16,0.5)	(0.25,0.15,0.5)	0

Figure 1. Fuzzy paired comparison matrix

We carry out defuzzification computation according to formula (2) and convert after the comparison with the threshold 0.5, so as to get the adjacency matrix A as Fig.2:

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11
S1	0	1	0	1	0	0	0	0	0	0	0
S2	0	0	0	0	0	0	1	0	0	0	1
S3	0	1	0	0	1	0	0	0	0	1	1
S4	0	0	0	0	0	0	0	0	0	0	0
S5	0	0	0	0	0	1	1	0	0	0	0
S6	0	0	0	0	0	0	0	0	0	0	0
S7	0	0	0	0	0	0	0	0	0	0	0
S8	1	0	1	0	1	0	0	0	1	1	0
S9	1	0	0	0	0	0	0	0	0	0	0
S10	0	1	0	0	0	0	0	0	0	0	0
S11	0	0	0	0	0	0	0	0	0	0	0

Figure 2. Adjacency matrix A

We can get the reachable matrix according to Boolean calculation. It can be seen that when $k=4$, $(A+I)^3 \neq (A+I)^4 = (A+I)^5$,therefore, we can obtain the reachable matrix M as Fig.3:

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11
S1	1	1	0	1	0	0	1	0	0	0	1
S2	0	1	0	0	0	0	1	0	0	0	1
S3	0	1	1	0	1	1	1	0	0	1	1
S4	0	0	0	1	0	0	0	0	0	0	0
S5	0	0	0	0	1	1	1	0	0	0	0
S6	0	0	0	0	0	1	0	0	0	0	0
S7	0	0	0	0	0	0	1	0	0	0	0
S8	1	1	1	1	1	1	1	0	1	1	1
S9	1	1	0	1	0	0	1	1	1	0	1
S10	0	1	0	0	0	0	1	0	0	1	1
S11	0	0	0	0	0	0	0	0	0	0	1

Figure 3. Reachable matrix M

4.2 Hierarchy Division.

We can decompose the reachable matrix M so as to obtain the reachability set $R(S_i)$ and antecedents set $A(S_i)$. When $R(S_i) \cap A(S_i) = R(S_i)$, S_i is the top hierarchical feature dataset. We can cross out the corresponding rows and columns in the reachable matrix and continue to fund the top hierarchical feature in the remaining reachable matrix after finding the top hierarchical feature collection. We can obtain the factor set in different hierarchies in this way. The first hierarchy reachable set $R(S_i)$ and antecedent set $A(S_i)$ are shown in Table 2.

It can be seen from Table 3 that the first hierarchy top hierarchical feature collection is $\{S_4, S_6, S_7, S_{11}\}$. We can obtain the second hierarchical reachable set $R(S_i)$ and antecedent set $A(S_i)$ after crossing out the corresponding rows and columns S_4, S_6, S_7, S_{11} in the reachable matrix and continue to fund the top feature in the remaining reachable matrix. We can obtain the feature collection in different hierarchies in this way. The five hierarchies top hierarchical feature collection in Enterprise E-learning training courses are respectively $\{S_4, S_6, S_7, S_{11}\}$, $\{S_2, S_5\}$, $\{S_1, S_{10}\}$, $\{S_3, S_9\}$ and $\{S_8\}$.

Table 2 First hierarchical reachable set and antecedent set

S	R(Si)	A(Si)	R(Si) ∩A(Si)
1	1,2,4,7,11	1,8,9	1
2	2,7,11	1,2,3,8,9,10	2
3	2,3,5,6.7,10,11	3,8	3
4	4	1,4,8,9	4
5	5,6,7	3,5,8	5
6	6	3,5,6,8	6
7	7	1,2,3,5,7,8,9,10	7
8	1,2,3,4,5,6,7,8,9,10,11	8	8
9	1,2,4,7,9,11	8,9	9
10	2,7,10,11	3,8,10	10
11	11	1,2,3,8,9,10,11	11

4.3 Establishment of Hierarchical Structure Model.

We can obtain the reachable matrix of hierarchy division according to the five hierarchical feature collections as Fig.4:

$$M' = \begin{array}{c} \\ S4 \\ S6 \\ S7 \\ S11 \\ S2 \\ S5 \\ S1 \\ S10 \\ S3 \\ S9 \\ S8 \end{array} \left[\begin{array}{ccccccccccc} S4 & S6 & S7 & S11 & S2 & S5 & S1 & S10 & S3 & S9 & S8 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 1 & 1 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 & 1 & 1 & 0 & 1 & 1 & 0 & 0 \\ 1 & 0 & 1 & 1 & 1 & 0 & 1 & 0 & 0 & 1 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{array}\right]$$

Figure 4. Reachable matrix of hierarchy division

It can be seen from the reachable matrix M' that system element s_4、s_6、s_7 and s_{11} are of equal values and affect each other. We can obtain the hierarchy architecture and sequence of situated learning oriented enterprise E-learning training course components through the induction and arrangement of system structural model as shown in Figure 5.

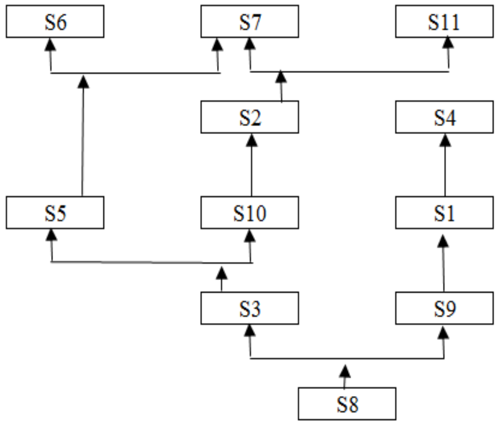

Figure 5. Hierarchy architecture and sequence

We can draw the following conclusions according to enterprise E-Learning training course system analog models. E-Learning training course system comes into operation when the enterprise has learning needs. This learning needs determine the carrier selection of curriculum strategy and situated learning in the training course design. Course objective depends on the specific work contents of learning needs analysis and the base level of the trainees. Carrier selection of evaluation criteria and situated learning is restricted by curriculum strategy. Model selection of situated learning is determined by curriculum strategies, which can reflect the requirements for learning needs analysis. Course content is on the basis of course objective, which is affected by the model selection of situated learning. Cognitive support runs through the learning activities, which is provided to the course strategy selected. Learning activities can reflect the learning strategy selected by using cognitive support. Information expression is the expression and representation of course contents and cognitive support. Course evaluation contents must meet the requirements for course objective. The evaluation form is affected by the carrier selection of situated learning. Situated learning is realized on the basis of course content.

It can be seen from the ISM chart of enterprise E-Learning training course system design that the ultimate goal of the construction of the E-Learning training course system is to meet the learning needs, to improve the employees' ability and make a contribution to the enterprise. We should pay attention to the following aspects in the construction and application of enterprise E-Learning training according to ISM theory and enterprise E-Learning training hierarchy division.

We should make the training needs clear in the frontal analysis, analyze the work contents of different posts, analyze the trainees' cognitive properties, threshold level and deviation degree and finally determine the E-Learning training course development in situated learning.

We should select the course objective, situated learning mode and carrier based on the course strategy and work out the course contents in the course planning process. The course contents shall not derivate from the course objective. We finally unify the evaluation criteria according to course objective and evaluation criteria, thus enhancing the objectivity of evaluation and facilitating the management.

We should learn the design so as to ensure the learning effect and make the trainees to be competent for the work after training. This part can guide the trainees to have better absorption of learning contents through cognitive support, learning activity and design of information expression.

5. Conclusion

This study analyzes the components of situated learning oriented E-learning training course design from the perspective of system science. It concludes the 11 components in situated learning oriented enterprise E-learning training course design on the basis of the questionnaire of the professional personnel, sets up the ISM of situated learning oriented enterprise E-learning training course design by using FUZZY-ISM technology, realizes the hierarchical analysis of the course training and clearly displays the internal relevance structure of system element, which is of significant practical application value.

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