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An Index System of Education Information Resources Selection Based on Analytical Hierarchy Process

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Abstract: In the face of massive learning resources, learners are confronted with resource selection dilemmas and cognitive load problems. In order to help learners or educators to choose personalized resources better, we combed the literature reviews on classic learner models, and from the perspective of learners' personalized characteristics, we analyzed and constructed an index system of education information resource selection based on college student preferences by using analytical hierarchy process (AHP), then the weight of each factor in the index system was determined through Delphi method, a specific course was taken as an example afterwards, which verified that the index system constructed is effective and scientific.

Keywords: Analytical hierarchy process, education information resources, personalized characteristics, learner preferences

1. Introduction

The contradiction between the surge of education information resources and the differences of learners' resource demands has led to information overload. Constructing a scientific index model of resource selection and mapping strategy has become hot off the press. In this case, what learners need indeed are to be urgently explored. Despite learner-centered instruction has long been the core idea of open education, the analysis on students' explicit and implicit needs seem to be continually neglected more or less, which is the very beginning point of realizing precise online education service. In order to improve the design effects of online learning systems and the quality of individualized learning resources recommendation, it is necessary to build a comprehensive, accurate, scientific and reasonable learner profile. The learner profile is a structured representation and storage of learners' preferences, cognition, abilities and situations, and then chooses appropriate schemas to describe learners' explicit and implicit characteristics. The purpose of the current study is first, to establish a learner characteristics profile served as a hierarchical structure model to construct an index model of education information resource selection and second, to verify the effectiveness of the index model to guide our further refinement on the models. The research question is proposed as follows:

RQ: How to construct a hierarchical index evaluating model to solve multi-criteria decision making with uncertain factors and help different learners select an optimal learning resource?

2. Construction of Index Model for Education Information Resource Selection

2.1 Brief Introduction of Analytical Hierarchy Process

Numerous highly uncertain factors are affecting learners' preferences for resource selection in specific time and places, some of which may even conflict with each other. Analytical hierarchy process (AHP), a qualitative and quantitative method, can be applied to decision analysis in various uncertain situations (Emrouznejad & Marra, 2017). Not rare are research on the application of AHP in the field of education, which can be roughly divided into the following five categories: (a) the quality evaluation of learning resources, (b) teaching quality evaluation, combined with Data Envelopment Analysis (DEA) or Multi-

choice Goal Programming (MCGP) method to reduce the non-computational error of AHP (Thanassoulis et al., 2017; Gurung & Phipon, 2016), (c) evaluation of students' learning quality, highly requiring a diversification assessing indicators which can reflect the internal and logical relationship, as well as conciseness and expansibility, (d) allocation of education resources, which is decided by balancing the weights and relationships among different indicators, (e) analysis of phenomenal factors, including the construction of problem models and the analysis of factors restricting or proposing suggestions through empirical methods.

2.2 Establishment of Hierarchical Structure Model

Through the comparative analysis of typical learner characteristics profiles and interviews with several experts as well as college students in related fields, this study proposes a learner characteristics profile based on college students' online learning preferences and personalized features. The complex problems of influencing factors of college students' education information resources selection can be divided into four levels: objective level O, first-class factor (indicator) level C, second-class factor (criterion) level P and alternative level A. The alternative level includes teaching plan (A_1), teaching courseware (A_2), micro-lesson video (A_3) and case-based video recording (A_4). The final hierarchical model is then established as is shown in Figure 2.

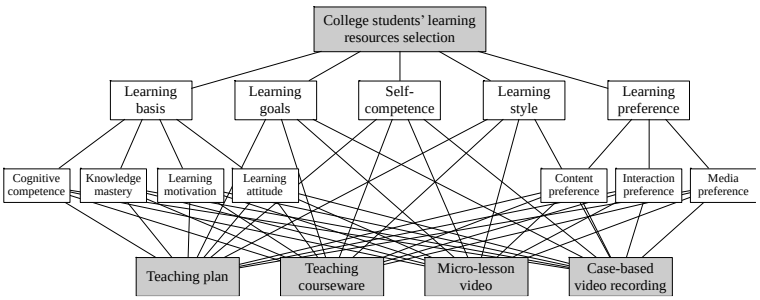

Figure 2. Hierarchical structure model.

2.2.1 Construction of Judgment Matrix

In order to obtain more reasonable and authoritative data, and therefore determine the scale of the impact of learner characteristics on resource selection, four experts were invited to compare the factors in the hierarchical structure model, assigning relative importance of each item as shown in Figure 3.

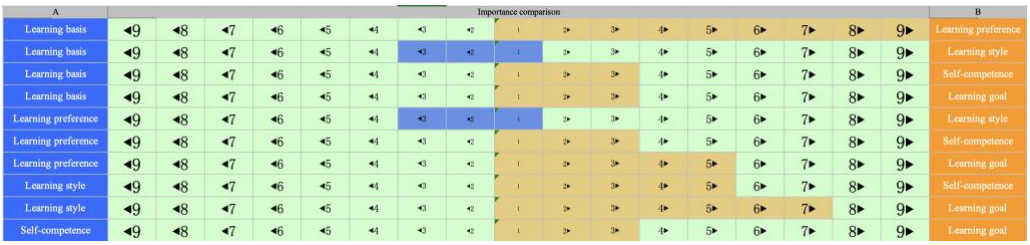

Figure 3. Evaluate the relative importance of learner characteristics for choosing resources.

2.2.2 Hierarchical Single Ranking and Consistency Check

Through iterative feedback and modification, a judgment matrix $\boldsymbol{E_k}(k = 1,2,3,4)$ is therefore obtained for each expert at the factor level. Hierarchical single ranking refers to the ranking order of comparing all elements in this layer with those in the upper layer. In this study, MATLAB is used to calculate the maximum eigen root λ_{max} of matrix $\boldsymbol{E_k}$, corresponding eigenvector $\boldsymbol{W}$ and weight vector $\boldsymbol{w}$ by sum method. The weight vector results are shown in Table 4.

Table 4

Combination weight vector result

Indicator level	Weight	Rank	Criterion level	Weight	Rank
Learning goal C_1	0.5050	1	/	/	/
Learning basis C_2	0.1334	3	Cognitive competence p_1	0.0554	1
			Knowledge mastery p_2	0.0474	3
			Learning motivation p_3	0.0118	7
			Learning attitude p_4	0.0188	4
Learning preference C_3	0.0739	4	/	/	/
Learning style C_4	0.0559	5	Content preference p_5	0.0486	2
			Interaction preference p_6	0.0119	6
			Media preference p_7	0.0133	5
Self-competence C_5	0.2318	2	/	/	/

3. Results

Course "Animation design and production" was taken to verify the validity of the above model results, resource preference selection experiments on 60 sophomores in two classes of a university in China were carried out. Each student has a computer to receive the distribution of four kinds of learning resources. Each type of resource has two files and strictly conforms to the curriculum standards and schedule which has been applied in practice before.

Students were required to select two of their favorite resources after browsing 8 learning resources and fill in the questionnaire. After eliminating and counting the invalid data, a total of 114 resource choices of 57 students were collected. The results of comparison between the weights of index model and experiments are shown in Figure 4.

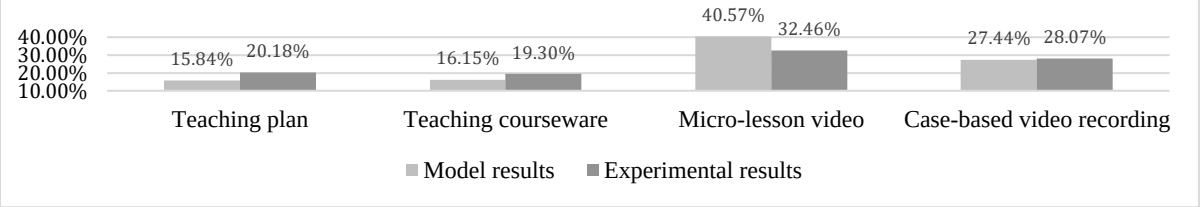

Figure 4. Comparison of the results of model and experimental data weights

4. Conclusion

This study constructed a learner characteristic model based on the personalized features of college students through comparative analysis of several classical learner characteristic models. Expert surveys and analytical hierarchy process were carried out to assign index weight of each learner characteristic factor. A course was taken and five learner characteristics with their sub-criteria factors in the index model were successfully verified through the experiment. The study provides a theoretical support for the application of learner models, as well as the design and development of algorithms for college students' personalized resource recommendation. More systematic selection and evaluation of learner characteristics combined with interpretive structural model methods are to be improved, to solidify the authority of learner models applied to specific research.

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