Application of cloud model theory to construct an evaluation model for network courses on College English

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Received 22 October 2014, www.cmnt.lv

Abstract

The cloud model is a model that mutually transforms the qualitative concept described in linguistic terms and the uncertainty in its representations using numerical values. Cloud model theory integrates the fuzziness and randomness of evaluation subjects and adopts an improved backward cloud algorithm to convert a qualitative concept into a quantitative value of an evaluation index such that the practical situations of each evaluation index can be described. Unlike traditional algorithms, this method does not use single numerical values alone for expression only but can also reflect the practical development trends of each index comprehensively and ideally. Thus, the theoretical model is of practical significance in evaluating the degree of satisfaction with network courses.

Keywords: Cloud model, evaluation of degree of satisfaction, College English, network courses, backward cloud generator

1 Introduction

The cloud model is a model that mutually transforms the qualitative concept described linguistically and the uncertainty in its representations using numerical values [1]. A cloud is composed of disordered cloud droplets, and one cloud droplet is represented whenever the qualitative concept maps the quantitative numerical value [2]. Therefore, a large number of cloud droplets enhance the accuracy of the expression of the overall features of the qualitative concept. When cloud droplets are highly likely to appear, the degree of certainty of these droplets increases along with the magnitude of their effect on the qualitative concept [3].

Cloud model theory has the following three numerical characteristics [2]:

(1) Expectation (Ex): the expectation value in the space of the discourse domain, which is the most representative quantization sample of the qualitative concept. Specifically, the distance from a cloud droplet to Ex reflects the degree to which cognition regarding the qualitative concept is unified.

(2) Entropy (En): a numerical value that to expresses the uncertainty of the qualitative concept mainly describes cloud droplet dispersion under the conceptual nature (i.e., the value range of the cloud droplets that can be transformed conceptually in the discourse domain)

(3) Hyper entropy (He): the entropy of En known as Hn. It mainly reflects two En features, namely, fuzziness and randomness (i.e., quantization of the uncertainty degree of En).

These three numerical characteristics show that the cloud model can reflect its qualitative concept quantitatively, can correlate randomness with fuzziness, constitute a mutual mapping relation between qualitative and quantitative features, and describes concepts regarding satisfaction degree through three one-dimensional clouds for normal satisfaction evaluation, that is, "dissatisfaction", "common satisfaction", and "satisfaction" [4].

With social development, tracking the progress of science and technology is increasingly difficult with traditional teaching methods [5]. Thus, network courses have been established in response to the proper time and conditions. Network courses boast abundant teaching resources [6]. Hence, teaching through network courses has gradually become an indispensable auxiliary teaching method to traditional teaching. Furthermore, network courses on the English language are significant given its popularity and wide application in modern society [7]. Nonetheless, network courses are characterized by space–time separation and do not adopt the face-to-face teaching approach, unlike in traditional courses [8]. Hence, teachers and experts are challenged with respect to obtaining students' reactions to such courses. Appropriate improvements to teaching are difficult to identify [9]. In this case, the construction of a set of scientific, effective, and uniform evaluation systems for the degree of satisfaction with network courses is profoundly significant [10]. These systems can not only help colleges implement network education but also ensure the continuous improvement of teaching levels.

At present, existing evaluation methods basically adopt qualitative language and advance work using questionnaires. The main evaluation system models that are commonly used include: (1) weighted mean method, (2) fuzzy evaluation, (3) rough set theory, and (4) cloud theory. Specifically, cloud theory integrates the fuzziness

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and randomness of evaluation subjects and realizes the mutual transformation and mapping between a quantitative numerical value and linguistic terms. Hence, it is widely applied in fields such as system evaluation, intelligence control, and data mining. The cloud theory model is also important role to education. Accordingly, Hu Shiyuan completed a qualitative and quantitative transformation process using cloud model theory. Moreover, Jiang Jian et al. applied cloud model theory methods to verify the feasibility and theory of the model to evaluate learning and teaching quality.

Network courses must be evaluated because it transfers the value judgment of evaluation objects to the value judgment of its components. In fact, this process decomposes targets until the final-stage indices can be tested directly or simpler and more detailed grading standards can be implemented. All evaluation indices constitute a complete evaluation system with an overall hierarchical structure. Over time, the quality of network education is increasingly examined, particularly with respect to the method that can be used to evaluate the advantages and disadvantages of network courses. Thus far, a set of authoritative evaluation systems has not been established.

2 Cloud generator

The cloud generator is an algorithm that uses software or hardware for cloud generation. It is mainly divided into a forward cloud generator (FCG) and a backward cloud generator (BCG).

2.1 FCG

The FCG maps a qualitative concept to a quantitative expression and generates cloud droplets according to its numerical characteristics (i.e., Ex, En, and He). Each generated cloud droplet is a reflection of the qualitative concept of the normal forward generator. The generator algorithms are expressed as follows:

Input: Ex, En, He, and the number of cloud droplets (n)

Output: quantitative numerical values of all cloud droplets and the conceptual determined values represented by each cloud droplet. Steps:

(1) The normal random number xi is obtained. Ex denotes expectation, while En is the variance.

(2) The normal random number En' is determined. Its expectation is denoted by En, while He is the variance;

(3) Values are calculated using the following formula:

$$y_i = \exp[-\frac{(x_i - Ex)^2}{2(Ex')^2}] \quad (1)$$

(4) Let (xi, yi) be a cloud droplet that maps the conceptual value of a cloud quantitatively and where xi is the value that corresponds to the xi qualitative concept. yi represents the specific measurement of the qualitative concept;

(5) All of the foregoing steps are repeated until the required number of clouds is obtained.

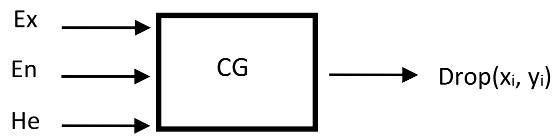

FIGURE 1 One-dimensional normal cloud generator

2.2 BCG

The BCG maps a quantitative numerical value into a qualitative concept. It completes the formation of the qualitative concept of the accurate data represented by numerical characteristics. The specific algorithm of the generator is written as follows:

Input: quantitative numerical value of each cloud droplet and the concept it expresses (xi, yi);

Output: qualitative concept A of the cloud droplets, which is represented by numerical characteristics Ex, En, and He. Steps:

(1) x_i is used to calculate $\overline{X} = \frac{1}{n}\sum_{i=1}^{n} x_i$, which is the sample average of this group of data; $\frac{1}{n}\sum_{i=1}^{n}\left|x_i - \overline{X}\right|$ is the absolute central moment of the first-order samples; and $S^2 = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \overline{X})^2$ is the sample variance;

(2) Based on step (1), we may obtain sample *Ex* (i.e., $Ex = \overline{X}$);

(3) In accordance with sample average, we can determine sample *En*, that is

$$En = \sqrt{\frac{\pi}{2}} \times \frac{1}{n}\sum_{i=1}^{n}\left|x_i - \overline{X}\right| . \quad (2)$$

(4) Sample *He* (i.e., $He = \sqrt{S^2 - En^2}$) can be calculated using the sample variance in step (1) and the sample *Ex* in step (3).

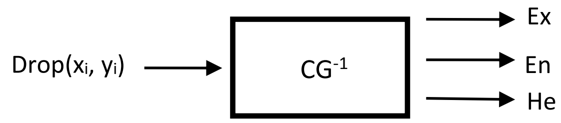

FIGURE 2 One-dimensional backward cloud generator

Thus, we use BCG to evaluate the degree of satisfaction with network courses in this model.

3 Evaluation system for the degree of satisfaction with network courses based on cloud model theory

3.1 PRINCIPLES OF THE EVALUATION SYSTEM OF NETWORK COURSES ON COLLEGE ENGLISH

Scientificity principle: To ensure that evaluation results can reflect course quality completely, the process by which index system is determined must be verified. Moreover, the designed evaluation schemes and models must be scientific, fair and reasonable.

Objectivity principle: To enhance the objectivity of evaluation results, we must limit the factors of evaluation subjects (e.g., subjectivity and emotion) in the process as much as possible. The method that combines qualitative and quantitative approaches is also adopted to analyze the data and to draw conclusions.

Completeness principle: To obtain a set of ideal evaluation system for network courses, we must start from three aspects, namely, student, teacher, and expert. Subsequently, the five systems in this set must be investigated comprehensively and an appropriate weight distributed to each index.

Feasibility principle: Feasibility is the most important and critical principle when the evaluation system is construed.

3.2 COMPOSITION OF THE EVALUATION SYSTEM OF DEGREE OF SATISFACTION WITH NETWORK COURSES ON COLLEGE ENGLISH

The process by which such an evaluation system is developed is quite complicated. Hence, we should emphasize the comprehensive performance of each course aspect in this process. We must use different weight index parameters to reflect the degrees of importance of the different modules. Meanwhile, evaluation standards should be multi-dimensional and contain at least three different types to be reasonable (i.e., student, teacher, and manager; Figure 3).

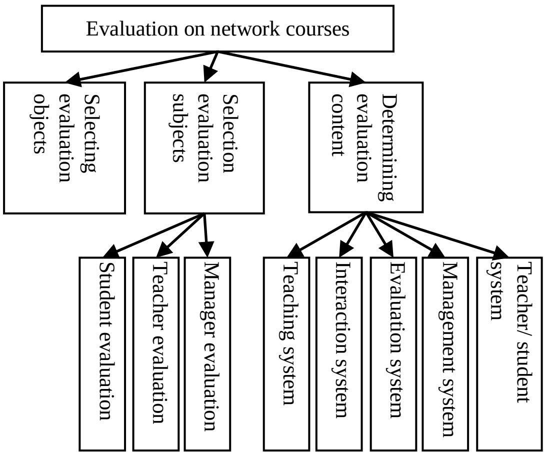

FIGURE 3 A flow chart about evaluation system about network courses

(1) Selecting evaluation objects

Evaluation objects are the objects to be evaluated. In this case, the evaluation object is the degree of satisfaction with network courses on College English.

(2) Selecting evaluation subjects

The evaluation of network courses mainly focuses on the student subjects, although we may also consider the participation of various kinds of people. Different evaluation subjects report different advantages and disadvantages. Therefore, analyzing these features specifically is an important method of optimizing and integrating evaluation indices. Such analysis also improves the quality and effectiveness of the course. Moreover, students are regarded as appropriate subjects for the evaluation system based on cloud model theory.

(3) Determining evaluation content

A typical evaluation standard system is developed according to the principles of system theory in consideration of universality, comprehensiveness, operability, model conciseness, and the content of the five necessary aspects of evaluation standards (Table 1).

TABLE 1 Evaluation system about network courses

Primary indexes	Content
Webpage	Interface shows friendly atmosphere, layout is reasonable, and the website adopts modular construction and can be comprehended by users easily, choose entrance and exit randomly and provide convenience for users at different levels and with different demands to use it.
Resource design	Content of resources should be rich and complete with prominent themes and can reflect framework and structure of the course as well as provide abundant background materials and multimedia resources.
Navigation system	Navigation should be clear and distinct with specific interlanguage. Its content should be searched easily and description and introduction about study module should be offered.
Evaluation system	Content design about online homework and online tests should be reasonably and it ought to have the functions self-scoring and query about historical performance records.
Interactivity	It can realize resource sharing, group discussion, on-line inquiry about homework and online answer etc.
External links	There should be complete links about related background materials of the course and related reference data as well as links about professional websites about related technology of related subjects. Ineffective links do not exist.
Learning support	In the process of course study, online technical support should be timely and effect and off-line approaches by which problems can be solved should be offered.

3.3 ANALYSIS OF APPLICATION CASES

To verify the effectiveness of the evaluation model, we apply the results of a survey on *College English* network courses as basic evaluation data. This survey is a questionnaire on degree of satisfaction, which was by conducted by the Ziqiang Network Teaching and Research Office of Hubei Bioengineering College with 186 students who had completed the network course by the end of the 2014 spring semester. A total of 200 questionnaires were issued, and 186 valid ones were returned. The ratios of Grades 1, 2, and 3 students are 17%, 64%, and 19%, respectively. The questionnaire survey is designed according to the principles listed in Table 1, and weights are not set for each index. Each primary index is subsequently divided into three to four secondary indexes for additional qualitative evaluation. The remarks set consists of the categories dissatisfied, a little dissatisfied, ordinary, relatively satisfied, and satisfied. The intervals of the remark grade values are presented in Table 2.

TABLE 2 Interval about values of remark grade

Evaluation grade	Scores range
Satisfied	(9,10)
Relatively satisfied	(8,9)
Ordinary	(6,8)
A little dissatisfied	(4,6)
Dissatisfied	(0,4)

To map the grade intervals for the qualitative remarks in the questionnaire, a backward cloud algorithm of multi-step reduction is used to limit the numerical characteristics and to evaluate index scores. The cloud model is then employed to represent the linguistic term index. Finally, the secondary indexes are weighed to identify the numerical characteristics of all the primary indexes in the cloud model (Table 3).

TABLE 3 Parameter list of the cloud model about evaluation indexes

Index	（Ex, En, He）
Webpage design	(0.654,0.653,0.124)
Resource design	(0.316,1.035,0.148)
Navigation system	(0.321,1.081,0.230)
Evaluation system	(0.256,0.874,0.135)
Interactivity	(0.325,1.267,0.168)
External links	(0.586,0.532,0.114)
Learning support	(0.195,1.255,0.324)

In the process, an evaluation cloud of all of the indexes is generated. The *Ex*, *En*, and *He* of the evaluation cloud are applied as a set of correlated atom concepts. Conceptual promotion is then conducted at different abstract levels or strengths. High-level concepts are thus generated. Finally, the essence of things is examined macroscopically. The atom concepts are then promoted in this thesis through a combination method based on arithmetic operation with the following specific formulas: $Ex = \overline{X}$, $En = \sqrt{\frac{\pi}{2}} \times \frac{1}{n}\sum_{i=1}^{n}\left|x_i - \overline{X}\right|$ and $He = \sqrt{S^2 - En^2}$. According to these formulas, the three numerical characteristics of the evaluation cloud are calculated as *Ex* = 65.542, *En* = 2.515, and *He* = 0.413.

3.4 ANALYSIS OF RESULTS

Based on the results, the Ex derived from the comprehensive evaluation of the network course is 65.542, which belongs to the interval (63,70). In addition, the evaluation results of this course is “satisfied” given that most of the other cloud droplets are distributed around the *Ex* according to the connotation of its numerical characteristics. The results in Table 3 suggest that the *Ex* of the network course for evaluation is the highest in terms of design, which indicates that the webpage design aspect of the course is effective. Furthermore, *En* is consistent with the evaluation results. The *Ex* of the external links is the lowest among all of the results, which implies the opinions of the evaluation subjects are consistent with respect to the external links. Meanwhile, the course is ineffective in terms of learning support, and *Ex* is minimal. However, *He* is maximal in this aspect. Thus, evaluators differ strongly in terms of psychological factors and are highly uncertain in evaluating this index.

4 Conclusion

In summary, the evaluation system based on the cloud theory model has the following advantages over previous traditional methods: This system integrates the fuzziness and randomness of evaluation subjects; the results are reliable; improving the BCG stabilizes the algorithm; the evaluation can reflect the practical situations of the evaluation objects comprehensively and accurately; and the complex evaluation process is simplified, which improves work efficiency. Cloud model theory can effectively combine the fuzziness of the evaluator regarding indexes with randomness and considers the subjective wishes of evaluation subjects during evaluation; hence, the actual evaluation results on the degree of satisfaction with network courses can be reflected objectively and comprehensively. This finding is significant to the development and precision of the evaluation system for network systems and has important promotional value as well. However, the evaluation model is inappropriate for the assessment of network courses with limited enrollees because of the considerable errors generated by the backward cloud algorithm. In the future, we may consider improving this algorithm to enhance the system model and to expand its application range.

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