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An integrated decision model for evaluating educational web sites from the fuzzy subjective and objective perspectives

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ABSTRACT

With advances in information and network technologies, lots of data have been digitized to reveal information for users by the construction of Web sites. Unfortunately, they are both overloading and overlapping in Internet so that users cannot distinguish their quality. To address this issue in education, Hwang, Huang, and Tseng proposed a group decision system to evaluate the quality of educational Web sites by users' and experts' opinions. Their investigative source is solely stemmed from human intention, called the *subjective perspective*, to make judgments on the quality of Web sites. However, the nature of human beings in making decisions has a gap between intention and behavior. Asking people for eliciting thought is arduous to cause this gap. Human behavior, namely the *objective perspective*, is the other essential source to obtain human thinking and real doings. For this reason, we can use data mining approaches to acquire the objective source. In this research, we propose an integrated decision model applied in evaluating educational Web sites from the fuzzy subjective and objective perspectives. The former source is extracted by inquiring human opinion using a questionnaire, while the latter is gained automatically by a data mining technique, fuzzy clustering. An empirical study is carried out to validate the model capability.

1. Introduction

With advances in information and network technologies, lots of data have been digitized to reveal information for users by the construction of Web sites. According to the Netcraft Web server survey in May 2009 (Netcraft, 2009), over 235 million sites have been built in Internet. Unfortunately, the *information overloading and overlapping problems* make a barrier when a user attempts to seek some information in his/her mind but loses his/her way in volumes of data. Since Web sites serve as a major portal to connect with these information, evaluating the quality or utility of Web sites becomes necessarily as a way to understand whether users are satisfied with these data or not. On the other hand, managers also lack to take into account what the structure and content of Web sites will affect a user's perception for the quality. To facilitate the work, a workable evaluation methodology needs to be established.

For evaluating the quality of Web sites, numerous studies have worked on different metrics to measure Web sites by various quantitative approaches. They can be classified into two types, *crisp* and *fuzzy*. The former only allows participants to express opinion by assigning absolutely either 0 or 1 score to targets so that we could deal with the problem easily. However, it might not be approaching reality to present our thinking naturally. For example, we may consider that a Web site is somewhat but not absolutely good about its quality; however, by this way, we only can treat it as good or not absolutely. The latter could remedy this problem so that participants can state opinion between 0 and 1. So, the quality of the Web site could be assigned to a score 0.8 for a good grade and 0.2 for another. In crisp type, Palmer (2002) developed metrics for assessing usability, design, and performance constructs to understand consumer-focused Web sites. Loiacono, Chen, and Goodhue (2002) generated a complete Web site quality measure designed to capture what a Web site design will influence a user's intention to reuse. Aladwani and Palvia (2002) reported on the development of an instrument that captures key characteristics of Web site quality from the user's perspective. Agarwal and Venkatesh (2002) presented a metric and procedure for evaluating the quality of an organization's Web presence. In fuzzy type, Hwang, Huang, and Tseng (2004) proposed a group decision system to evaluate

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the quality of educational Web sites by users' and experts' opinions. In summary, all studies tend to develop an approach to inquire users' thinking about some dimensions for the quality of Web sites. Their investigative sources are solely stemmed from human intention, called the *subjective perspective*, to study the quality issue.

Based on the theory of reasoned action (TRA), scholars believe that human intention is positively related to behavior (Fishbein & Ajzen, 1975). Unfortunately, the nature of human beings in making decisions sometimes has a gap between intention and behavior. Asking people for eliciting thought is arduous to cause this gap. In Legris, Ingham, and Collerette study (2003), the difficulty with self-reported use is also the problem to lead to the gap. An interesting report pertaining to this problem can be referred to Appendix A. Human behavior, namely the *objective perspective*, is the other essential source to obtain human thinking and real doings. For the Web behavior, we use the past browsing logs from users to analyze their actual usages of Web sites. As the result, if a user visits a Web site with a longer time and clicks Web pages more times, we believe that s/he is content with the presentation and content of the Web site. Therefore, we can gather the user's certain perception according to a series of the real behaviors without interrupting the user.

To our knowledge, Zhou, Ma, and Turban (2001) have proposed an integrated subjective and objective approach to evaluate the quality of journals by fuzzy sets. Their subjective perspective, called the perception analysis approach, extracts opinion from experts. The approach only asks one question, i.e. please give your judgment on a journal, to determine a journal's grade. Consequently, many factors will not be concerned within this perspective. Besides, their objective perspective, called the citation analysis approach, determines the rankings of journals based on the impact factors provided by journal citation reports. Managers also need to participate in this process to determine each membership degree for each grade complicatedly. Finally, they integrate the both to provide a comprehensive consideration for assessing the quality of journals.

The information overloading and overlapping problems discussed above are especially significant in the type of educational Web sites. In Taiwan, an interest of higher education evaluation and accreditation in university assessment has been pursued (Heeact, 2009). A group of professionals developed standards to evaluate higher education institutions, commissioned by the Ministry of Education. Their proposed evaluating dimensions, however, do not involve in addressing the quality of the educational Web sites. Without considering the dimension, we cannot hold the total educational quality thoroughly since most of educational resources have been presented in the fashion of Web sites.

As judging the quality for journals, assuring that for Web sites also encounters the same circumstance. In this research, we propose an integrated decision model, called *Fuzzy Subjective and Objective Perspectives* (*FuzzSOP*), for evaluating educational Web sites in Taiwan from the fuzzy subjective and objective perspectives. We use the Palmer questionnaire (Palmer, 2002), a rigorous metrics, to solicit human opinion for the former. It improves the Zhou et al. (2001) approach in the subjective perspective. Also, we analyze Web logs by applying a data mining technique, fuzzy clustering, to gain the latter automatically. Fuzzy clustering betters the Zhou et al. (2001) way of the objective perspective to streamline the complex process and reduce the degree of human participation. To validate the model capability, we conduct an empirical study to examine the quality of educational Web sites.

The balance of this paper is organized as follows. Section 2 reviews the related works of the proposed model. Section 3 formally describes the integrated model, FuzzSOP, from the fuzzy subjective and objective perspectives. Section 4 explains a FuzzSOP algorithm by an example and conducts an empirical study for evaluating educational Web sites practically. Finally, conclusions are drawn in Section 5.

2. Related works

To approach real thinking and behavior from human beings, we will apply fuzzy techniques to combine the subjective and objective perspectives for evaluation. As follows, we introduce the rationales and related works of fuzzy sets in Section 2.1 and those of fuzzy clustering in Section 2.2.

2.1. Fuzzy sets

The theory of fuzzy sets was first proposed by Zadeh (1965). It can model the imprecise and qualitative knowledge, as well as the transmission and handling of uncertainty at various stages of our real life. The idea of fuzzy sets is that we can assign objects to a set with values between 0 and 1, differing from that of crisp sets, i.e. values only assign either 0 or 1. To compute values, a membership function is given to obtain the membership degrees of objects in a fuzzy set. When the membership degree for an object is '1', it means that the object is absolutely in the set. On the other hand, '0' means that the object is absolutely not in the set. Borderline cases are assigned to the values between '0' and '1'.

Pervious researches of fuzzy sets have been conducted to cope with various evaluating problems. Adopting the idea of fuzzy sets is an efficient and effective means to represent the uncertainty and vague terms in an assessment environment. Hwang et al. (2004) proposed a fuzzy system to evaluate the quality of educational Web sites by users' and experts' opinions. Ma and Zhou (2000) proposed a fuzzy set approach to assess the outcomes of student-centered learning. Capaldo and Zollo (2001) used fuzzy logic to a rating problem in personnel assessment. Dweiri and Kablan (2006) presented an approach that employs fuzzy decision making for the evaluation of the project management internal efficiency. Other applications in engineering can be referred to in Ross (1995) and those in business or management are also in Bojadziev and Bojadziev (1997).

2.2. Fuzzy clustering

Clustering involves the task of dividing objects into homogeneous clusters, so that objects in a cluster are as similar as possible, and those in different clusters are as dissimilar as possible. The most well-known and commonly used partitioning method is *k*-means. It takes the input parameter, *k*, and partitions a set of *n* objects into *k* clusters so that the resulting intra-cluster similarity is high but the inter-cluster similarity is low. Cluster similarity is measured in regard to the mean value of the objects in a cluster, which can be viewed as the cluster's center of gravity.

In the above traditional clustering, objects are divided into crisp classes, where each of them belongs to exactly one cluster. In fuzzy clustering, however, objects can belong to more than one class, and associated with each of objects are membership grades which indicate the degree to which objects belong to the different classes.