A decision support system to develop a quality management in academic digital libraries

Francisco Javier Cabrerizo [a,*], Juan Antonio Morente-Molinera [b],
Ignacio Javier Pérez [c], Javier López-Gijón [d], Enrique Herrera-Viedma [b,e]

[a] Department of Software Engineering and Computer Systems, Universidad Nacional de Educación a Distancia (UNED), Madrid 28040, Spain
[b] Department of Computer Science and Artificial Intelligence, University of Granada, Granada 18071, Spain
[c] Department of Computer Sciences and Engineering, University of Cádiz, Cádiz 11519, Spain
[d] Department of Library Science, University of Granada, Granada 18071, Spain
[e] Department of Electrical and Computer Engineering, Faculty of Engineering, King Abdulaziz University, Jeddah 21589, Saudi Arabia

ARTICLE INFO

ABSTRACT

Academic digital libraries are getting more benefit from the Web possibilities to help with teaching, learning and research activities. Because of it, more and more people use the services that they offer. Therefore, it is very important that the academic digital libraries provide a good service in order to satisfy the users' expectations. The aim of this paper is to present a decision support system assisting the staff of the academic digital libraries to make decisions in order to meet the users' needs and, in such a way, to increase the number of users utilizing them. To do so, the decision support system is composed of several decision rules which generate recommendations according to both objective and subjective criteria to improve the quality of the services offered by the academic digital libraries.

1. Introduction

The arrival of the World Wide Web has enabled the proliferation of new sources of content and information. In 2008, Web 2.0 technologies made possible user-contributed content to directly compete, in scale and popularity, with the traditional "content" industries such as newspapers, magazines, TV, video, books, and so on [1].

One of these new sources of information is the academic digital library [2,3], which plays an important role in bridging students, academicians and researchers' needs of information [4]. Whereas the library used to be an obvious first port of call when seeking information, several studies reveal that this is no longer the case. For instance, a study undertaken by the Pew Internet and American Life Project in 2007 found that almost 60% of respondents would consult the Internet, while just over 10% would consult the public library [1,5].

Academic digital libraries can integrate research resources and enable users to search for specific information in virtual space [6]. On the one hand, several sources of information as, for example, electronic bulletin boards, online databases, and local magnetic or optical databases, are available only in electronic form [7]. On the other hand, academic digital libraries can support intellectual and academic endeavors not only for information seeking but also for researching, exploring and growing their knowledge by adapting the information systems and human–computer–interaction technologies [4].

* Corresponding author. Tel.: +34913988409.
E-mail addresses: cabrerizo@issi.uned.es (F.J. Cabrerizo), jamoren@decsai.ugr.es (J.A. Morente-Molinera), ignaciojavier.perez@uca.es (I.J. Pérez), jgijon@ugr.es (J. López-Gijón), viedma@decsai.ugr.es (E. Herrera-Viedma).

As a result of the popularity of the academic digital libraries, there are many people whose expectations and demands are increasing for better quality and functionality of the services offered by the academic digital libraries. Consequently, a major challenge faced by academic institutions is how to measure the performance of their digital libraries in the context of users' perspectives and how far their digital libraries satisfy the users' needs.

Measures related to richness of resources have tended to be used to evaluate the quality of academic digital libraries. Traditional measures such as the number of journal subscriptions, number of volumes owned, size of budget, number of patrons served, and so on, have been used in the quality evaluation of academic digital libraries [8]. However, measures based solely in terms of number of resources have become outdated. Since an academic digital library, and any other type of digital library as well, is designed to be used for people, its performance should be evaluated with a new approach considering users' needs. That is, the quality of academic digital libraries must be evaluated by their users.

Several quality evaluation methods of digital libraries based on users' perceptions have been proposed in the literature [9–11]. These methods provide the performance that the users perceive on the services offered by the academic digital libraries, but not give any advice or suggestion to improve them. However, it is important not only to obtain the quality level of the services offered by the academic digital library but also providing some recommendations in order to improve them and, in such a way, to fulfill the users' expectations. Academic digital libraries are designed to support users and if they do not meet the users' expectations, they fall into oblivion and terminate their operation [10].

The objective of this paper is to present a decision support system (DSS) to develop a quality management in academic digital libraries. It supports the staff to make decisions with the aim of improving the quality of the services offered by the academic digital library. To do so, the DSS takes into account several subjective criteria which are related to users' judgments. However, although it is essential to consider the users' opinions in the quality evaluation of academic digital libraries, it does not mean that all traditional quantitative criteria have to be excluded. Hence, the DSS also incorporates some objective criteria which are related to the quantitative data of the academic digital library. According to the subjective and objective criteria, the DSS provides some recommendations to improve the service and functionality of the services provided by the academic digital libraries in order to increase the number of users accessing to the academic digital library and the number of queries that they execute. The DSS is based on a set of decision rules that are activated depending on the values of the objective and subjective criteria. The values of the objective criteria are obtained from the data supplied by the academic digital library, whereas to obtain the values of the subjective criteria, an approach following the quality evaluation model based on fuzzy linguistic information presented in [12] along with the LibQUAL+ methodology [13,14] is used. The main innovation of the paper is to present the first DSS to develop a quality management in academic digital libraries which incorporates quality qualitative and quantitative criteria and recommendation rules to help the staff to make decisions.

The paper is set out as follows. In Section 2, we introduce the theoretical bases of our DSS, i.e., the fuzzy linguistic approach for computing with words and the LibQUAL+ methodology. Section 3 describes the DSS proposed in this contribution. To illustrate the application of this DSS, three Spanish academic digital libraries are evaluated in Section 4. Finally, we offer some concluding remarks and future work in Section 5.

2. Preliminaries

The theoretical bases of the DSS rely on the tools outlined in this section. Firstly, we introduce the ordinal fuzzy linguistic approach for computing with words. Secondly, we describe the LibQUAL+ methodology.

2.1. A fuzzy linguistic approach for computing with words

There exist many problems where the information cannot be assessed precisely in a quantitative form but it may be done in a qualitative one, and therefore the use of a linguistic approach is necessary [15].

The fuzzy linguistic approach is a suitable technique to deal with fuzzy and qualitative aspects of problems. Here, the information is modeled by means of linguistic terms supported by linguistic variables [16–18], which are defined via a syntactic rule and a semantic rule, and whose values are not numbers but sentences or words in a natural language.

The fuzzy linguistic approach is less precise than the numerical one, but it presents the following advantages: (i) the linguistic description is with ease understood by human beings even when the context is changing or the concepts are abstract, and (ii) it decreases the effects of noise since, as it is known, the more refined the assessment scale is, the more sensitive to noise it becomes (linguistic scales are less refined than numerical scales and consequently they are less sensitive to error apparition and propagation).

Among the different linguistic approaches existing in the literature [15], the ordinal fuzzy linguistic approach is very useful because it facilitates the fuzzy linguistic modeling very much as it simplifies the definition of the semantic and syntactic rules.

The ordinal fuzzy linguistic approach [19,20] is defined by considering a finite and totally ordered linguistic term set $S = \{s_i\}$, $i \in \{0, \ldots, g\}$, where $s_i < s_j$ holds if and only if $i < j$. Usually, the set is composed of an odd number of linguistic terms, seven or nine, representing the mid-term an assessment of "approximately 0.5" and the rest of the linguistic terms being situated symmetrically around it. The semantics of the linguistic terms is established from the ordered structure of the set by considering that each linguistic term for the pair (s_i, s_{g-i}) is equally informative. As example, a set composed of nine linguistic terms could be as follows: $S = \{s_0 = None, s_1 = Extremely\ Low, s_2 = Very\ Low, s_3 = Low, s_4 = Medium, s_5 = High, s_6 = Very\ High, s_7 = Extremely\ High, s_8 = Total\}$.