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Evaluation and selection of group recommendation strategies for collaborative searching of learning objects ☆

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ABSTRACT

Nowadays, there is a wide variety of e-learning repositories that provide digital resources for education in the form of learning objects. Some of these systems provide recommender systems in order to help users in the search for and selection of the learning objects most appropriate to their individual needs. The search for and recommendation of learning objects are usually viewed as a solitary and individual task. However, a collaborative search can be more effective than an individual search in some situations – for example, when developing a digital course between a group of instructors. The problem of recommending learning objects to a group of users or instructors is much more difficult than the traditional problem of recommending to only one individual. To resolve this problem, this paper proposes a collaborative methodology for searching, selecting, rating and recommending learning objects. Additionally, voting aggregation strategies and meta-learning techniques are used in order to automatically obtain the final ratings without having to reach a consensus between all the instructors. A functional model has been implemented within the DELPHOS hybrid recommender system. Finally, various experiments have been carried out using 50 different groups in order to validate the proposed learning object group recommendation approach.

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1. Introduction

Web searching is generally considered to be a solitary activity, and all major search engines and Web browsers are designed for solo use. However, many tasks in both professional and casual settings can benefit from the ability to jointly search the Web with others (Morris, 2008). In the educational domain, for example, a group of instructors in the same course may be interested in searching for and selecting together the educational resources most appropriate to develop a new digital course. That is, instead of only one instructor being in charge of developing the courseware, or several of them developing different parts of the courseware, all the instructors in the course would be together searching and selecting the resources to be used in the course. This type of searching in a group is called a "collaborative search" and it allows many individuals to benefit from preferences and experiences of other like-minded individuals (Smyth et al., 2011).

A learning objects (LOs) search is one of the most time-consuming tasks for instructors, because finding the most appropriate objects to match a specific subject is not always easy. An LO is a basic component (unit of a course) or modular digital resource that can be used to support learning (Wiley, 2002). For example, Fig. 1 shows the interface of an LO on learning the English language, which is oriented to learners between 12 and 20 years old in order to promote their reading and comprehension skills.

A vast amount of LOs are published and distributed across the Internet in repositories such as MERLOT (Schell and Burns, 2002), MACE (Stefaner et al., 2007), AGORA (Prieto et al., 2008), ARIADNE (Ternier et al., 2009), etc. Facing huge volumes of LOs, instructors may be lost when selecting the most suitable LOs to be used in a specific course. In order to resolve this problem, recommender systems have been successfully applied to provide suggestions about LOs which can be most useful to the individual knowledge, goals and/or preferences of each user (Manouselis et al., 2011). However, there are situations when it would be good if we could recommend to a group of users rather than to an individual. The main problem in group recommendation is determining how a group of people reaches a consensus about the score for each item in a way that reflects the interests and preferences of all group members. Nowadays, there are some examples of group

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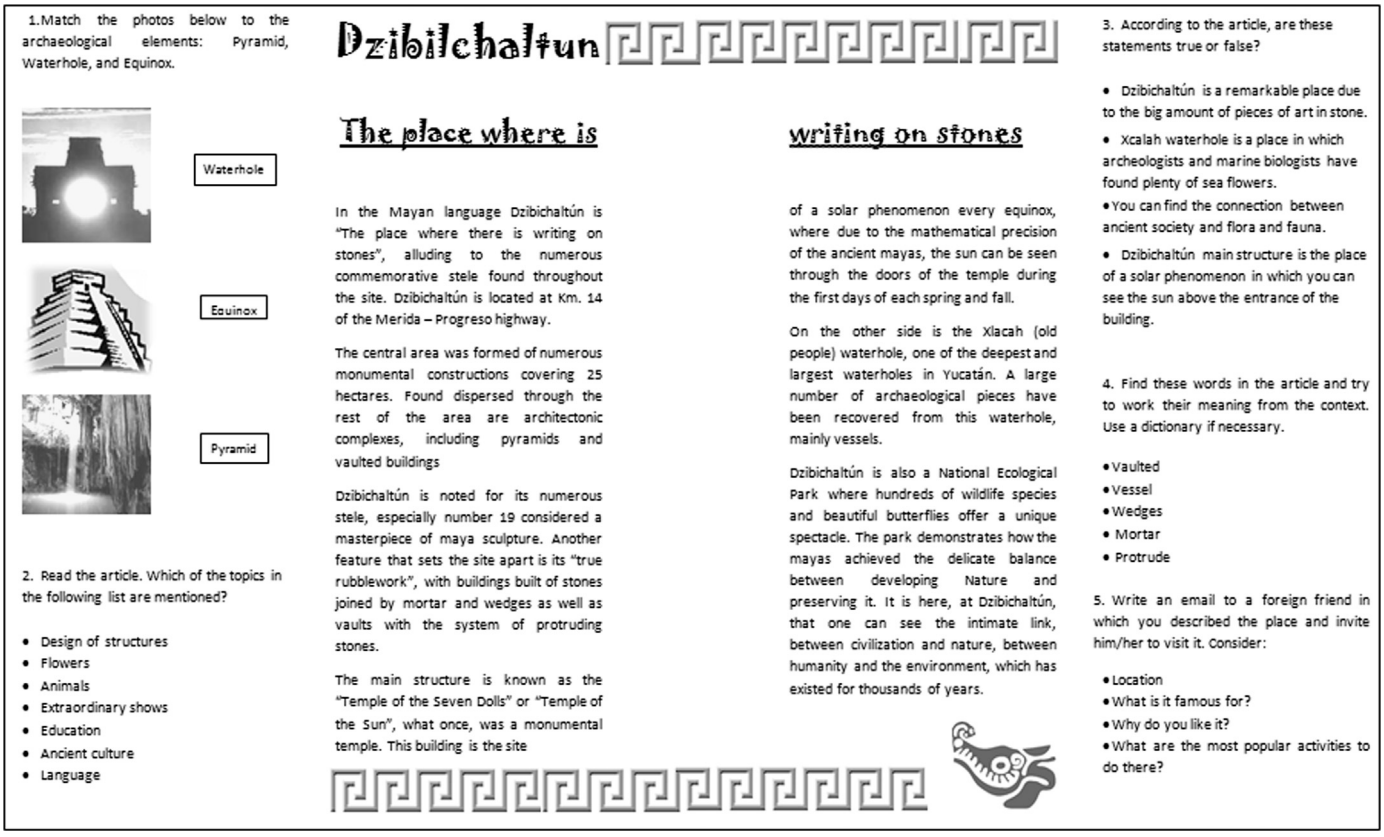

Fig. 1. Example of learning object on learning the English language.

recommenders for selecting television programmes for a group to view or for selecting a sequence of songs to listen to in a group (Masthoff, 2011). However, in the current bibliography, we have not found any group recommender systems in the education domain or specifically for LO repositories.

This paper proposes a collaborative methodology for searching, selecting and rating LOs in a group. We have implemented this methodology into a hybrid recommendation system called DELPHOS (Zapata et al., 2013), which is a framework to assist users in the single/individual personalised search for learning objects in repositories (http://smile.esi.uclm.es/delphospruebas/). We have extended DELPHOS with new functionalities, including the creation and management of groups of users, the realisation of collaborative activities, and the recommendation of the most interesting LOs to these groups. We also propose a meta-learning approach in order to help the mediator of a group to select the best rating aggregation method depending on the rating of previous similar groups. For one thing, the mediator is free to use any of the available aggregation strategies to automatically obtain the LO ratings from a group of users, without needing to use the traditional democratic in-person or online discussion to obtain a consensus from all the group members about each LO. But also, the mediator can directly use the best aggregation strategy recommended for a group based on its characteristics. In this way, the traditional time-consuming consensus-taking among users can be avoided by using an automatic method based on meta-learning and voting aggregation strategies.

The remainder of the work is organised as follows: Section 2 describes the related background and the most similar works; Section 3 describes the proposed methodology; Section 4 shows the implementation of this methodology within the DELPHOS system; Section 5 describes the experiments and results for validating the efficiency of this system with groups of real users; finally, Section 6 outlines some concluding remarks and future research lines.

2. Background and related work

This work deals with the specific problem of evaluating and selecting voting aggregation methods for assisting the search for the best LOs appropriate to the interests of a group of instructors. In this section, we introduce the subjects most relevant to this work. We start with concepts of collaborative social search, then we introduce group recommender systems, and finally we explain data mining and meta-learning concepts.

2.1. Collaborative web search

Collaborative web search (CWS) is an activity in which participants work together in a synchronous or asynchronous collaboration in order to satisfy an information need (Morris, 2013). Nowadays, CWS is generally implemented around mainstream Web use rather than for LOs. It can be divided into implicit or explicit collaboration:

Implicit search engines. These are characterised by identifying similar users, queries and links clicked automatically, and by recommending relevant queries and links to the searchers. Some examples of these systems are as follows:

- *Jumper* 2.0 (Jumper Networks Inc., 2011), which empowers users to compile and share collaborative bookmarks by crowd-sourcing their knowledge, experience and insights, using knowledge tags.

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