Supporting the Creation of Scholarly Bibliographies by Communities through Online Reputation Based Social Collaboration*

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Abstract. Bibliographic digital libraries play a significant role in conducting research and, in the past few years, have started to move from closed to more open social platforms. However, in this, they have faced challenges (e.g., from Web spam) in maintaining the level of scholarly precision—the ratio of relevant citations retrieved by search. This paper describes a hybrid approach that uses online social collaboration and reputation based social moderation to reduce the cost and to speed up the construction of scholarly bibliographies that are comprehensive, have better quality citations and higher precision. We implemented selected social features for an established digital humanities project (the Cervantes Project) and compared the results with a number of closed and open current bibliographies. We found this can help in building scholarly bibliographies and significantly improve precision outcomes.

Keywords: Social collaboration, social moderation, social reputation, scholarly bibliography, digital libraries, digital humanities.

1 Introduction

Closed bibliographic digital libraries (BDLs), manually compiled by authorized users or automatically-generated, have existed for many years. Recently, *open social* BDLs (e.g., CiteULike[1]) have emerged. However, for specific research needs, a satisfactory level of precision and comprehensiveness is not entirely attained by either of these approaches. Current bibliographic search engines show a limited scope of coverage on literature. There is no single resource that handles the entire 2.5 million articles that emerge yearly from the 25,000 peer-reviewed journals [1], so these engines

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[1] http://www.citeulike.org

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access only a fraction of the literature [2]. From this limited literature, researchers concentrate further on specific groups of conferences and journals, missing other valuable related research outside of their immediate scope.

Beyond the increased information availability resulting from the increasing number of journals and conferences and their inclusion in digital libraries, there is a growing movement towards open access archives. This increases the availability of research resources in the online communities. As a consequence, papers that are not available electronically for various reasons may lose their presence in the research community.

Many digital humanities projects manually maintain online BDLs that support diverse users in locating a variety of references. In this paper we will use the example of the Cervantes Project's[2] bibliography (CIBO), which aims to represent the best resources published since 1605 about Miguel de Cervantes, the author of Don Quixote, drawn from many multilingual sources. The current CIBO bibliography gathering and filtering process is carried out by sets of contributors: the expert editors, the reviewers, and the authorized international collaborators. Consequently, delays, possibly months, can result from gathering, filtering and indexing of new publications into the CIBO.

We believe that precise social collaboration systems are a way to address each of these issues: increasing amounts of striated information, increased invisibility of offline literature, and manually-introduced delays in filtering bibliographic information.

Most online bibliographies provide services to their users while prohibiting them from contributing. This results in a considerable loss of external knowledge. The current state of the art is moving toward two ways of interaction, where the users can benefit from the available knowledge and contribute to it. Hendry, et al. [3], mention an "amateur bibliography" that is collected by non-professionals and falls short of the standards of a professional bibliography. Although large number of references could be collected in a short span of time, this results in issues such as redundancy (repeated citations), spam, phantom author names, and phantom citations. These are not good signs of scholarly research [4] and would affect the significance of a journal (e.g., impact factor [18]) or a publication (e.g., h-index [19]). Spam also threatens social websites to undermine resource sharing, interactivity, and openness [5].

Social moderation models are elements that assist in unifying online groups to achieve consensus about common interest topics, reduce spam content, and identify members' reputations. This approach works well for social interaction and open collaboration and has been accepted in those uses. However, there is controversy about the moderation effectiveness of open environments in achieving acceptable levels of quality content and identification of users' reputations. Moderated systems have faced problems such as insufficient attention to posts, moderation delays, unfair moderations, and premature negative or positive consensus [20].

This paper's premise is that online reputation-based social collaboration (ORSC) can reach the precision level of the scholarly moderated bibliography [13] by benefiting from the "wisdom of the crowds" [6]. This approach would be more comprehensive than the regular closed bibliographies and more accurate than the open social citations websites. This would lead researchers to the required and current resources from multiple sources in less period of time. We have experimented with this issue by

[2] http://cervantes.tamu.edu/

implementing online social functionality for the CIBO. We have tested them on a group of CIBO users from different countries who use a variety of languages to gather, share, annotate, rank and discover academic literature. We compared our precision outcomes with a number of highly recognized, closed (e.g., WorldCat[3] and MLAIB[4]) and open (e.g. CiteULike and Bibsonomy[5]) online bibliographies.

This paper is structured as follows. We discuss the related work in Section 2. Section 3 explains the approach we used and our implementation. We present and discuss these current experiments and results in section 4. In section 5 we conclude and highlight some of the future work.

2 Related Studies

We compared main features supported by various current well-established humanities BDLs. Table 1 summarizes the main outcomes. These BDLs were initiated as long as a decade ago and most do not incorporate the social collaboration mechanisms of Web 2.0 such as social bookmarking, tagging, reviewing, ranking, etc.

Table 1. Humanities BDLs supported features

Bibliography / Features	Cervantes Project	World Shakespeare Bibliography	The Galileo Project	The Walt Whitman Archive
Developer	TAMU	Shakespeare Quarterly	Rice University	Ed Folson & Kenneth M. Price
Established	1995	1950 (physical records)	1995	1995
Searching	√	√	√	√
Browsing	√	√	√	√
Multilanguage Content	√	√	×	√
Multilanguage Interface	√	×	×	×
Review	×	√	×	√
Social Collaboration	×	×	×	×

Collaboration in bibliographies exist in several systems from areas other than the humanities. The ShaRef system [9] supports collaboration between groups of researchers. It provides authentication and access control features. Heymann, et al. [8], concluded that social bookmarking can provide search data not currently provided by other sources, though it may currently lack the size and distribution of tags necessary to make a significant impact. Santos-Neto, et al. [7], showed that the current level of collaboration in CiteULike and Connotea is consistently low. Users are adding new items much faster than they are reusing them. Only a small number of user pairs share interest over items and use the same tags, which significantly limits the potential of harnessing the social knowledge in communities. This explains the cause of the

[3] http://www.worldcat.org
[4] http://www.mla.org/bibliography
[5] http://www.bibsonomy.org/

relatively high spamming levels. The majority of the online social citation collections are swamped with a high level of spam [5, 10, 11]. This is a classic Web 2.0 problem: it's hard to aggregate the wisdom of the crowds without aggregating their inexperience or madness as well [12]. Bogers, et al. [11], reported, using different sizes and dates of datasets, that around 93% of BibSonomy users and 28.1% of CiteULike users are spammers, posting 84% and 31% of the spam articles and bookmarks with 88% and 53% spamming tags. [10] mentions that web spam has started targeting more specific communities, such as the scholarly world, and introduced a variety of features to fight spam in social bookmarking systems. They evaluated them with well-known machine learning methods, using the BibSonomy dataset for their experiments.

We compared the main social collaboration features of the most four popular online social citations websites (Table 2).

Table 2. Comparison of social citations features

Online Social Citations / Features	2collab[6]	BibSonomy	CiteUlike	Connotea[7]
Multilanguage interface	×	English and German	×	×
Social Bookmarking	√	√	√	√
Social Tagging	√	√	√	√
Social Reviewing	√	√	√	√
Social Ranking and Sorting	√	×	×	×
Social Filtering	√	√	×	×
Groups of interest	√	√	√	√
Reputation based social moderation	×	×	×	×

We found that most online social citations sites support the well-known social collaboration features, providing a similar set of group types in moderating the citations: *private*, *closed*, and *open*. In these three types of groups, the community is not reaching the full potential of true collaboration. In the private group the community is isolated from the world and only the previously known members can contribute. In the closed groups there is a special need to approve a member. In the open groups there is an urgent need for checking the members' contributions.

Many testing, redundant, phantom and spam citations and groups exist in these systems. All of these groups assign moderators manually, which is time consuming, and may have some influence or bias from the creators of the group. Furthermore, moderators may lose interest or be inactive for a long period of time. Moreover, in such interdisciplinary bibliographies it is hard to decide if a citation is spam or not unless it is clearly obvious or was added to a specialized group and the group members suggest that it is not related to the group's interest. None of the previous attempts that we know tried to merge the approaches in an ORSC.

[6] http://www.2collab.com
[7] http://www.connotea.org

3 Extending the CIBO to Support ORSC

We enhanced the existing CIBO interface to support online reputation-based social collaboration, as will be described in this section. We then compared precision results from the augmented CIBO and selected popular sites; see section 4.

3.1 Reputation Based Social Collaboration

Considering the high level of spam in social citations websites, there is a need to reflect the accuracy and quality of the users' contribution and reputation in the community when allowing them to moderate, but also there is the need to continue to benefit from the openness of self-selection.

A user's contribution can be any of these elements; citation *(C)*, tag *(T)*, rate *(R)*, review *(V)*, translation *(N)*, or filter *(F)*. Users can add new citations, tag citations, rate citations by selecting a score out of five, review citations by commenting on them, translate citations, and filter spam citations by marking them. We have three types of memberships, which are user (u), collaborator (b) and moderator (m). Users can search and share but their contributions will be moderated. We allow approval of the contributions by a moderator or by *n* collaborators; $n=(1+ceiling(JB/AB))$, where *JB* and *AB* represent the rejected and approved contributions from collaborators.

Sabater and Sierra [24] present an extensive study on a set of reputation systems considering social relationship between users. These models compute reputation based on specific elements such as ratings, levels of participation, and quality of posted information. Chen, et al. [22], present a user reputation model that is used in an user-interactive question and answer system. It combines social network analysis and user ratings. Other researchers [23] present user reputation model for a digital library and digital education community that combines individual and collaborative activity. The weights assigned to each element depend on the specific society [24].

Our model is based on a multidimensional approach. It considers the user's activity and members evaluations. The elements selection and its assignment of weights were based on CIBO moderators' experience. Our members upgrading or downgrading is done using a social reputation [21]; users obtain higher reputation in the community by having accurate contributions and receiving credits from other users. Users can be upgraded to collaborators. A collaborator can be upgraded to a moderator. Initially, we seeded the moderator list with well-known Cervantes scholars and contributors. A summary of the moderation rules and privileges are shown in Table 3.

Table 3. Moderation rules

Controls / Members	Create contribution	Approve contribution	Edit contribution
User (u)	√	×	×
Collaborator (b)	√	√ *n*b	×
Moderator (m)	√	√	√

We summarize the social reputation by using the following formulas:

If the summation of user (u) contributions $S(u)$ and the summation of users evaluations to those contributions $E(u)$, according to the element importance, time of contribution, order, and evaluator reputation (ER), exceeds a threshold value D then the user will be upgraded to collaborator. If $(S(u)+E(u))>(D\times log\ X)$, then the user will be upgraded to moderator. X is the total contributions in the system.

$S(u)$ (formula 1) is used to compute the user contributions. $S(u)$ sums the approved user contributions of C, T, R, V, N, and F after multiplying them by specified weights a to f that represent the importance of that element. $X(u)$ sums the approved user contribution of element X for a user (u), where $X \in \{C,T,R,V,N,F\}$. X_i^u represents a single user (u) contribution (i). We also multiply the sum of user contributions by reciprocal of t_i and o_i, where t_i stands for the time from the citation appearance in the literature to the time it was contributed in the CIBO, or the time from the contribution to the time of a follow up contribution such as adding new tags, rates, reviews, translations or filters. o_i stands for the order of the contribution. This will allow valid earlier contributors to gain more points that advance them to higher ranks in the community.

$$S(u)=a\sum_{i=1}^{C(u)}\left(\frac{C_i^u}{t_i}\right)+b\sum_{i=1}^{T(u)}\left(\frac{T_i^u}{ot_i}\right)+c\sum_{i=1}^{R(u)}\left(\frac{R_i^u}{ot_i}\right)+d\sum_{i=1}^{V(u)}\left(\frac{V_i^u}{ot_i}\right)+e\sum_{i=1}^{N(u)}\left(\frac{N_i^u}{ot_i}\right)+f\sum_{i=1}^{F(u)}\left(\frac{F_i^u}{ot_i}\right) \quad (1)$$

To compute users evaluations we use $E(u)$ (formula 2). EX^u is a single evaluation of contribution X. $E(u)$ sums the users evaluations (EX_{ij}^u), for the user contributions after multiplying them by specified weights a' to f' that again represents the importance of that element.

$$\begin{aligned}E(u)=a'\sum_{i=1}^{C_i^u}\sum_{j=1}^{EC_j^u}(EC_{ij}^u\times ER)+b'\sum_{i=1}^{T_i^u}\sum_{j=1}^{ET_j^u}(ET_{ij}^u\times ER)+c'\sum_{i=1}^{R_i^u}\sum_{j=1}^{ER_j^u}(ER_{ij}^u\times ER)+\\ d'\sum_{i=1}^{V_i^u}\sum_{j=1}^{EV_j^u}(EV_{ij}^u\times ER)+e'\sum_{i=1}^{N_i^u}\sum_{j=1}^{EN_j^u}(EN_{ij}^u\times ER)+f'\sum_{i=1}^{F_i^u}\sum_{j=1}^{EF_j^u}(EF_{ij}^u\times ER)\end{aligned} \quad (2)$$

In order to compute D, we use formula 3, where U stands for the total number of users, J the total number of rejected contributions, A the total number of approved contributions, and E the total number of evaluations.

$$D=\log(U)+\log\left(\frac{J}{A}\times E\right) \quad (3)$$

3.2 Social Technologies Applied to Bibliographies

A set of social collaboration features was implemented in CIBO to support the open social collaboration environment. Figure 1 shows the main interface as it displays a citation's details.

Fig. 1. Screenshot for a citation's details

3.2.1 Social Bookmarking

Users can participate by providing new citations using the social bookmarking feature, importing citations or manually entering them. Figure 2 shows points gained by a user after several entries.

Fig. 2. Detailed view of contributors' points

3.2.2 Social Tagging

Del.icio.us and Digg are two of the popular and fastest growing social bookmarking sites that use folksonomy tagging. However, inaccurate and misleading tags are common in such open environments, which cannot be accepted in scholarly research communities. We prevent these effects by moderating the new users' tags. Users can create their own tags or reuse the previously entered tags by them or other users using auto-complete tags in real time; the implementation uses AJAX technology.

3.2.3 Social Ranking

Bibliography ranking has been used as a way to give users confident Top-N resources from the search results. A typical user only reads the first, second, or third page of

results. Citations have been used as a way to rank bibliography resources. Citation-based methods deal with complex issues such as bias or self-citations, hard to detect positive or negative citations, multiple citations formats difficult to handle by computer programs, unfair consideration of new papers, venues not considered [14, 15, 16]. Other researchers [17] proposed a seed-based measure (considering top-venues and venues' authors relevance) and the browsing-based measure (considers user's behavior) to rank academic venues. However, the authors-seed needs to be updated frequently to reconsider new relevant authors. We implemented a hybrid approach, where we allowed users to rate citations on a scale of five points while benefiting from bibliographic citation details. Each user has a different weight for rating the citation according to the user reputation.

3.2.4 Social Reviewing

We implemented a feedback environment to build an active online research community. It provides reviews and comments from the users where they can interact and clarify unclear points.

3.2.5 Social Translation

As digital libraries expand their audience and content scope, there is an increasing need for resources and access tools for those resources in a variety of languages [14]. The Cervantes Project's international scope requires the inclusion of content and system functionalities in multiple languages, since Cervantes literature has been translated to various languages and bridges between cultures need to be established.

Users can choose the preferred available language at any moment while using the system. This choice will automatically translate the interface to that language and will select only the content with that language. Using the Google Translate API [25], we provided a translation capability for the comments. Bibliographic data can be entered in a language and then manually translated to a new language or linked to existing bibliographic data or publications in other languages (Figure 3).

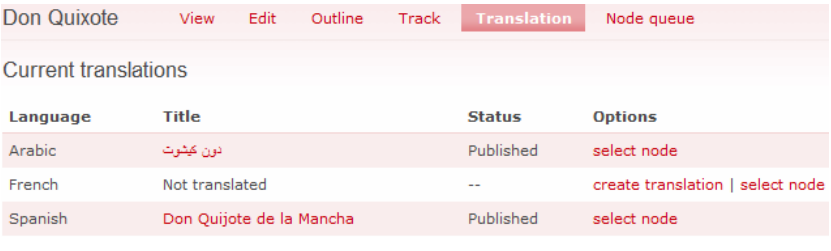

Fig. 3. A publication available translations

3.2.6 Social Filtering

Retrieving citations that are irrelevant, incorrect or spam frustrates the researchers and affects their productivity. We tried to mitigate this scenario by empowering the users to discover and filter any such results, spam, or spammers by reporting them for moderation. It is more as a social encouragement, since first users who discovered and reported these results would be given higher weights compared with subsequent users who report them. A moderator or *n* Collaborators (see 3.1) can approve the requests

by editing or hiding contributions or banning a spammer. Moderators will be able to view these changes for any follow up request and future statistics.

3.2.7 Social Discovery and Networking

By providing the previous social facilities, we allowed the researchers to share and discover latest academic literature without worrying about inaccurate bibliographic data. They can search and browse the citations contributed by the users, collaborators, moderators, or combination of them. They can discover what the hot topics are in the research field and what is significant to other like-minded researchers by viewing what they read, cited, tagged, ranked, or reviewed. Therefore, they can identify the related researchers with similar interest that they can network with.

4 Evaluation and Discussion

From the set of online citations websites available on the Internet, we selected the most reliable closed sites to digital humanities and the most popular open social citations sites. We used two closed BDLs, WorldCat and MLA International Bibliography (MLAIB), and four open social citations websites, CiteULike, Connotea, 2collab and BibSonomy, that contain millions of citations. We compared their precision outcomes with the augmented CIBO. Precision in our experiments was calculated as the number of relevant citations retrieved by a search divided by the total number of citations retrieved by that search at several milestones. Cervantes Project experts decided the common keywords and tags that are used in Cervantes literature, and we used those as search terms. The experts also evaluated the relevancy of retrieved documents. After gathering the results from the different resources, we found that Connotea and 2collab contain only few citations about Cervantes. Therefore, we removed them from the comparison. Table 4 shows a sample of precision to CIBO at the first 10 retrieved citations compared with CiteULike, BibSonomy, WorldCat and MLAIB. We used different lengths of keywords and tags combinations to search the bibliographies. Table 5 shows the average precision percentage % at 10 (P10), 20, 30, 40, and 50 for the bibliographies.

Table 4. Precision at 10 from different bibliographies

BDLs / Search terms	WorldCat	MLAIB	CiteULike	BibSonomy	CIBO
Cervantes	80	100	30	30	100
سيرفانتس	0	0	0	0	40
Quixote	100	90	50	50	90
Quijote	100	90	50	50	90
Cervantes plays	90	40	30	00	80
Miguel de Cervantes Poetry	30	10	0	0	100
Cervantes Windmills	80	100	30	10	80
Sancho panza	100	100	20	0	100
Dulcinea	80	80	10	0	50
Cervantes Blanket	10	30	10	0	0
Cervantes Island	30	30	0.0	0	90
Cervantes Persiles	80	70	10	0	90

Table 5. Average of precision from 10 to 50

Precision% / BDLs	P10	P20	P30	P40	P50
CIBO	91	38	23	15	11
WorldCat	78	36	24	17	13
MLAIB	74	31	20	15	11
CiteULike	24	8	5	4	3
BibSonomy	14	4	2	1	1

Figure 5 shows that CIBO performs better than all the compared BDLs at precision 10. At precision 20 it is still ahead with 2% from WorldCat. At precision 30, WorldCat goes ahead with 1%.

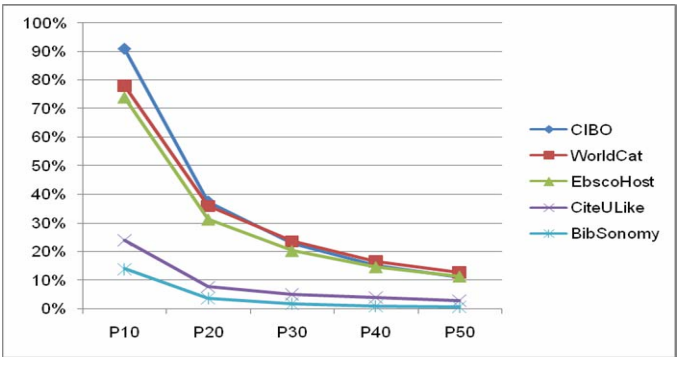

Fig. 5. Precision of the compared BDLs with CIBO

While CIBO achieved higher precision at 10 and 20, its precision started to decrease later on. This pattern occurs mainly because the users' rate and filter the initial results while neglecting the subsequent outcomes.

Our findings show how closed BDLs have considerably enhanced precision performance over the open social citation systems. This seemingly justifies the argument of scholarly communities to keep using closed environments but also increases the limited scope of coverage on literature. However, using the ORSC approach produces a precision performance competitive to general and closed bibliographies on searches for Cervantes-related topics. It also supports the personalization of the information and shows who are the active researchers. This visibility helps identify researchers for future collaborations.

5 Conclusion and Future Work

The open bibliography environments were originally conceived as websites for exchanging citations and reviews of global publications, taking advantage of the large communities available on the Internet. These sites offer a variety of benefits, but the lack of moderation brings high levels of spam. In addition, many contributors are

more enthusiastic than experienced. A lack of moderation may be acceptable for social sites but regarding scholarly communities, the content quality is a priority.

In this paper we have investigated the precision outcomes of a hybrid bibliography system created by an online digital humanities community. Our current experimental results indicate that using ORSC would improve the quantity and usage of scholarly bibliography and improve the quality and creditability of social citations sites.

We intend to automate more portions of the moderation process by checking the contributed citations to the closed and open online citations websites. We will evaluate the reviews and comments (positive or negative) by identifying and interpreting annotation patterns and semantics to give a relevance weight to each source, which would help also in the ranking. We plan also to investigate the existing work identifying hidden spam to get statistics to automate the process of filtering.

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