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Assessing Resource Bias and Engaging Students To Personalize Class Content through Internet Social Tagging

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There has been a long history of chemistry instructors who have looked for methods to introduce more modern and relevant chemistry topics into their courses *(1–8)*. The World Wide Web is an excellent resource, although the amount of information can be overwhelming. Even more importantly, students must be trained to have a healthy skepticism about the material they encounter on the Web because they tend to treat everything on the Internet as equally trustworthy. Social tagging,[1] one of the utilities that forms a part of social networking, provides one way to respond to these challenges. Social tagging is a powerful information organization tool, and it provides an opportunity for instructors to teach students about assessing electronic resources for bias. Additionally it allows students to make course topics more relevant by working with Web sites that they find personally interesting.

The Web is growing too rapidly for traditional classification methods based on hierarchal structures created by information specialists. As David Weinberger points out *(9)*, the U.S. Library of Congress daily catalogs ~7,000 new books; by contrast, ~7,000,000 new pages are added to the WWW each day. Historically, individual users have used a list of bookmarks on their browsers to try to relocate useful Web sites, yet these lists are not portable and the default is a chronological sorting sequence. One popular response to the problem of organizing large quantities of Web information has been the expanded use of social tagging, or as it is sometimes called, collaborative filtering, to look for Web sites *(10)*. This strategy takes advantage of Web-based utilities that allow lists of Web resources to be accessed from any computer and tagged with a series of keywords that allow the sites to be sorted for relevance as needed.

Social tagging has already found an extensive variety of applications *(11)*. Some examples include Flickr[2] and YouTube,[3] which use social tagging to organize media such as photos or videos. In addition, Connotea[4] is a social tagging site used to locate Web references, which allows direct access to scientific articles that have an assigned digital object identifier (DOI). The DOI is convenient because it is not dependent on the URL for the electronic document. Google[5] provides several free services that may also be of interest; for example, Google Notebook provides a simple way to collect notes, images, and links when doing a research project, and Google Docs allows multiple users to create and edit documents online.

"Delicious"[6] was one of the first social tagging sites *(12)*, and according to at least one measure *(13)*, it is among the top three social tagging sites in terms of popularity. It is simple to use, free, and functions on many different types of computers and operating systems. It is also possible to create independent accounts so that an individual faculty member may maintain class accounts that are separate from his or her personal account. Posting and tagging Web sites may be done either through logging into the Delicious account and pasting a target site's URL into a box on the Web page, or browser buttons may be downloaded to make the process even more convenient. The keyword tags are separated by spaces, although compound words such as SocialTagging or social_tagging are allowed. Widespread use of Delicious makes it more likely that the students who continue to use tagging after the course ends will encounter other Delicious users with whom they can easily share Web sites.

Including social tagging in chemistry classes is an opportunity to teach students both how to organize information better and to become more proficient at evaluating the quality and bias of Web information. The project also creates a structure for incorporating relevant and recent Web-based information into a course, and it allows students to personalize the content of the class by selecting specific, relevant material that corresponds to their individual interests.

Project Design

The incorporation of social tagging into a chemistry course was carried out twice. The pilot project was implemented in a class for nonscience majors with eight students during summer 2007. Feedback from that experience informed a revised project design that was incorporated into a graduate-level environmental chemistry course in the fall of 2007. The seven students enrolled in the environmental course included upper-division undergraduate chemistry majors and masters-level environmental engineering students. Although both courses had the advantage of small enrollments, the primary reason for selecting these two groups was that each course included a focus relating traditional chemistry content to issues of politics, business, and society.

In both projects, the decision was made to have the entire class use the same Delicious account. It is possible to share tags among different accounts, although by sharing a single account the instructor had access to all of the student work and had the option of editing the entries if desired. Learning to tag Web sites using the Delicious utility is quite straightforward, yet it still seemed advantageous to minimize complexity for the students. For each of the 8–10 assignments, students were required to log on to the class's online account on Delicious, post a link to a Web site relevant to the material being covered in lecture, and provide keywords to tag the content of the Web site. To guide

the students in their Web site searching, keywords related to the corresponding lecture content were suggested, although these keywords were not required to be used as tags. To make grading easier, the students were also asked to tag their Web sites with their initials as the first tag and then add subsequent keywords to classify the Web site. Using this strategy, it was easy to match students' paperwork with the corresponding Web sites.

For each Web site tagged, students were required to complete a standard checklist of quality criteria so that they would learn some strategies for assessing the information presented on a Web site. The instructor generated a form by consulting several Web resources to suggest criteria to help students evaluate both the quality and the intent of the Web sites that they viewed *(14, 15)*. The original version of the checklist asked a yes or no question of whether or not the Web site contained bias, but as the pilot project progressed, it became apparent that a more helpful question was to ask *how* the Web site was biased.

Especially from the outset of the second version of the project, the students and instructor worked from the premise that all Web sites contain some element of bias. Although in some cases bias may consist of selecting data that agree with a predetermined position or ignoring any data that are unfavorable, bias is not always necessarily a result of censorship. For example, it may be reasonably assumed that the U.S. Environmental Protection Agency's (EPA) Toxic Release Inventory (TRI) data found online *(16)* are an accurate reflection of the material found in the original report; the bias in these data would be a result of how the original data were collected. Only releases of the 650 chemicals on the official TRI list must be reported, so for example, there are no emissions of uranium reported at all; uranium is not on the required report list. Likewise, only industries of a certain size are required to comply with the TRI reporting, so many small releases are unreported on the TRI. It might be argued that some sources contain little or no bias, yet training students to assess Web sites actively for some level of bias enhances their skepticism and counteracts the students' tendency to trust all information that is found on the Internet.

With such a strong focus on the identification of bias, it was interesting to note the biases that the students introduced into the project. In both classes, the students displayed a bias for tagging Web sites that they thought had value and good quality. On the last assignment in the environmental class, one student specifically tagged a poor quality Web site that was badly organized and had many broken links, but that was a rare example. Another type of bias in selecting Web sites emerged from the environmental class. A large number of the Web sites tagged were from the EPA, and five of the students reported on the evaluations that they developed specific sources that they preferred to start from when selecting a Web site. Four of the students listed the EPA as their preferred source and one student named the U. S. Geological Survey *(17)* as the preferred source. These overlapping preferences only once led to the same Web page being tagged by two different people, and on any given assignment there was usually a maximum of two students who tagged sources from the EPA, so this bias from the students did not create a problem for the class content.

One of the initial research questions of the pilot study asked whether or not a group social tagging account was sufficient to substitute for a textbook. Previously, students in the nonscience majors class had complained on evaluations that because the tests were linked directly to the lecture material, the textbook was an unnecessary expenditure. The current editor of this *Journal*, John Moore, has likewise mused that at some point, the availability of high-quality, technology-based learning materials may reduce or eliminate the need for a traditional hardcopy textbook *(18)*. Upon examination of the Web sites tagged by the students, it was observed that students did not necessarily select resources that adequately explained the core content of the lecture, suggesting that social tagging was not an effective replacement for a textbook. This analysis by the instructor was supported by the project assessment provided by the students, detailed below.

Based on this result from the pilot project, the second project was designed specifically so that the social tagging system would be an enhancement for the textbook and not a replacement. This shift in focus took advantage of the true strength of the Internet. The textbook revision cycle for advanced classes is longer than for introductory courses, and as a result, annual data presented in an advanced text may be significantly out of date. By taking advantage of data available on the Internet, students were able to view the most current data on topics such as global temperatures, the Antarctic ozone hole, or the regulation of pesticides. This value-added strategy proved to be a much more effective use for social tagging.

A second change informed by feedback from the pilot study was that in the original project, the attempt to establish a social network through social tagging was largely passive. The students were not required to look at Web sites tagged by their classmates, and the material from the tagged Web sites was rarely included in class unless the students mentioned it. The failure to emphasize the supplementary material resulted in few of the students viewing the other Web sites on the Delicious account. Only two of the eight students looked at more than three of the other Web sites, and two of the students did not look at any of the other Web sites. In direct response to feedback from the first group of students, the second project was designed to pay more attention to the social component of the network. At the beginning of each class, time was devoted to looking at several of the Web sites that had been tagged. Sometimes the instructor scanned the sites in advance and selected a few to feature; sometimes the students requested that their Web sites be viewed and discussed. As a result, five of the seven students in the second class agreed with the statement that looking at Web sites tagged by their classmates was useful.

One outcome of the design to use the social tagging to allow students to add detail and depth to the textbook content for the class was that students used the opportunity to tag Web sites as a means of personalizing the material in the course. For example, one student was very knowledgeable about cars and trucks. He tagged a site about biodiesel for the discussion of alternate energy, a site about halon fire suppression systems in race cars for the discussion of CFCs and ozone depletion, and a commercial diesel engine site for the discussion about particulates. Likewise, for the discussion of pesticides and toxic organic substances, a student who was originally from India tagged a site describing deaths and health issues linked to endosulfan use in her home country. In each case, these students specifically requested that their Web sites be viewed and discussed at the beginning of class, thus allowing these individuals to include their classmates in topics of interest. The students were able to contribute to the shape and focus of the class content, thus increasing their engagement.

Challenges and Limitations

The use of keyword tags proved to be an initial challenge for some of the students in both classes. Students would periodically forget to include their initials in the list of tags so a Web site could not be identified as having come from a particular student. Students also did not grasp that the idea of the keywords was to make as many connections as possible, so they tended to list only the keyword they had used to find the site. As noted above, words separated by a space become different tags, so the students needed to learn to merge words to get a single tag, such as "AirPollution". In the second project, more time was spent on the first day of class going through the process of selecting a Web site and choosing tags, and the students learned the skill much more rapidly. Because the Delicious account in each class was shared instead of belonging to just one person, sometimes the tags were used in several different forms so that the maximum overlap was not achieved. For example, two students tagged "AlternateEnergy" and four students tagged "AlternativeEnergy." Misspellings also produce keywords that became separate tags instead of matching the correctly spelled tag. Although these limitations did not produce a social tagging site with the maximum use of overlapping tags, ultimately, the site was largely left as the students created it and keywords were not edited by the instructor.

Assessment

Assessment was carried out in both classes by the use of slightly different questionnaires at the end of the courses separate from the overall course evaluations. The forms were a mixture of questions with five-point Likert scale responses and open-ended questions. In Table 1 below, a score of 5 corresponded to students responding "strongly agree" to the item.

The second version of incorporating the social tagging project was much more effective than the first, and this result was reflected by the increased value in the average student response from 3.86 to 4.67 to the question asking whether the project helped the students learn to analyze Web sites for reliability. Similarly, the students in the second class agreed unanimously (score of 5.0) that the project was an effective means of incorporating current data into class discussions. That concept was also identified as a strong point of the first course by a student in the nonscience majors class who reported on the course evaluation, "relevant topics were discussed using not out-of-date resources".

The emphasis on bias developed during the first course in which Delicious was used. Three students from that class mentioned on the open-ended evaluation questions that an increased awareness of bias on Web sites was a valuable result of the assignments. The emphasis on bias was made stronger in the second class, and the student responses reflected an increased awareness of the concept. They agreed that the project helped them to identify bias in resources (average score of 4.43). On a pair of similar items asking whether the students assessed Web sites for bias before and after the project, the scores were 3.00 and 4.29, which suggested that the students developed the necessary skills to identify how resources might be biased *and* that examination for bias had become a habit.

The evaluations also reinforced the observation that social tagging was more effectively used to supplement textbook material and not to substitute for the traditional text. In the first class, the average student score of 3.13 was decidedly neutral about using the Delicious material in place of a textbook. The substantially higher score of 4.38 agreeing with the idea that the students were comfortable without a textbook was consistent with comments from previous students that the material on exams was taken exclusively from the lecture material, so the text-

Table 1. Comparative Assessment Results of the Social Tagging Projects in Two Classes

Statements for Response (Scale of 1–5, with 1 corresponding to "strongly disagree" and 5 corresponding to "strongly agree")	Average Score for Nonscience Majors, Summer 2007 (*N* = 8)	Average Score for Chemistry or Engineering Majors, Fall 2007 (*N* = 7)
How many Web sites did you look at on average before you selected one to tag? (Give number of sites.)	3.00	4.57
This project helped me learn to analyze and assess Web sites for reliability and accuracy.	3.86	4.67
This project allowed for the incorporation of current data into class discussions.	—	5.00
This project helped me learn to identify bias in resources.	—	4.43
Prior to this project, I usually assessed Web sites for their potential bias.	—	3.00
Having completed this project, I usually assess Web sites for their potential bias.	—	4.29
The Delicious project made this course more interesting and engaging.	—	4.57
The material on Delicious was a good substitute for a textbook.	3.13	—
I was comfortable not having a textbook for this class.	4.38	—
This project was an effective supplement to the textbook.	—	4.57
Internet search engine preferred by the students	Google (88%)	Google (71%)

book was not a necessity. In the second project where the social tagging was intended only to supplement the text, the students agreed (with a score of 4.57) that the project was effective.

Conclusions

Introducing students to social tagging Web sites provided them with an important tool for organizing Web resources; in addition, this approach was an effective way to increase student engagement and teach critical thinking skills.

- Social tagging is most effectively used to supplement a textbook and incorporate current data and information into class discussions.
- The social tagging project helps students learn to assess Web sites for quality and bias.
- Social tagging allows students to personalize the content of a class.

Future Directions

Although the project ran quite effectively in the second course, students still contributed ideas for future improvements. These ideas include reducing the number of assignments down to five or six per semester, as well as enhancing the network-building activities by having students critique each other's Web sites or compare and contrast multiple Web sites tagged with the same keywords. Because the project will be repeated when the courses are next taught, the students in the environmental chemistry class were asked on their project evaluations whether they would recommend starting with a clean Delicious account for a future class or starting with the account from the previous class. The consensus was that future classes should work with a clean account to give the next group of students the experience of becoming familiar with the available information and the process of tagging Web sites. A clean account will also mean that both the tagged Web sites and the data will be up-to-date.

Notes

1. Social tagging is the term for finding, storing, sharing, and managing Web bookmarks, usually with keyword "tags" ascribed to the bookmarks. For a general overview and additional links, see the entry for social bookmarking in Wikipedia: *http://en.wikipedia.org/wiki/Social_bookmarking* (accessed Oct 2008).

2. Flickr is an online photo management and sharing application accessible through the Web. Using this service is free, although sign-up is required. See the Flickr Home Page: *http://www.flickr.com/* (accessed Oct 2008).

3. YouTube is an online video management and sharing application accessible through the Web. Using this service is free: viewing content requires no login; uploading content requires registration. See the YouTube Home Page: *http://www.youtube.com/* (accessed Oct 2008).

4. Connotea is an application from Nature Publishing Group accessible through the Web that allows users to collect, store, and share their links to any page on the Web. Specifically designed for scientists and clinicians, Connotea has extra features for some Web sites, including PubMed and many journals, which allow it to recognize the page being saved and automatically collect bibliographic information. Using this service is free, although sign-up is required. See the Connotea Home Page: *http://www.connotea.org/* (accessed Oct 2008).

5. Originally a Web search engine only, Google offers other online services, such as Google Notebook (for collecting and storing information from the Web), and Google Docs (for creating and sharing documents online). Using the search engine is free: viewing content requires no login; sign-up is required to use Google Notebook, Google Docs, and other features. See the Google Home Page: *http://www.google.com/* (accessed Oct 2008).

6. Formerly named "del.icio.us", the Delicious Web site serves as a social bookmarks manager for storing and sharing users' Web bookmarks, often annotated with keyword tags. This service is free, although sign-up is required. See the Delicious Home Page: *http://delicious.com/* (accessed Oct 2008).

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