

Using Diigo to Engage Learners in Course Readings: Learning Design and Formative Evaluation

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This paper discusses the design and formative evaluation findings of a learning unit using a social bookmarking tool, Diigo. The unit's purpose was twofold, to teach a new tool and to facilitate learner interactions surrounding course content. During this unit, students shared and tagged relevant resources with their classmates and engaged in collaborative article annotation. Findings show that most students were active participants and had a favorable reaction to the learning activity. Several students indicated that they already had or planned in the future to use Diigo again, either individually or collaboratively, for both personal and professional purposes. Students who did not have a favorable reaction to the activity struggled to use the technology or focused solely on the technology component of the activity. For future semesters, greater emphasis will be placed on the content that students share and annotate, with the tool de-emphasized as a means to an end.

Keywords: annotation, bookmarking, learner interaction, social learning

Introduction

Social bookmarking tools provide people with opportunities to share web-based resources and to collaboratively analyze those resources using annotations. Annotations include descriptions, highlights, and comments that relate to a bookmarked item. Social bookmarking is often an informal activity performed by networked individuals who are pursuing similar personal or professional interests. However, social networking tools also can be used purposefully within a formal learning environment. In this context, students and teachers collaboratively bookmark and annotate curricular-related content. This formative evaluation study focuses on the design and initial implementation of a social

bookmarking unit in a university-level course, exploring student reactions to and preferences about different elements of the activities that made up the unit.

Literature Review

Social bookmarking can be an effective strategy for engaging higher education students with both authentic content (e.g., journal, newspaper, and magazine articles) and their scholarly peers. When social learning methods are used, students are “presumed to build more knowledge through the process of sharing and discussing knowledge and experiences” (Razon, Turner, Johnson, Arsal, & Tenenbaum, 2012, p. 350). Gao (2013) found that exposure to multiple viewpoints was one benefit of using social bookmarking tools. Other studies have found that social annotation processes support learning better than individual paper-based annotation (Chen, Hwang, & Wang, 2012) and level of social activity when using annotation features was positively related to final grades (Nokelainen, Miettinen, Kurhila, Florén, & Tirri, 2005).

Social bookmarking activities, like online or social media-based knowledge sharing activities in general, have many benefits for learners. Through these activities, learners can develop skills that will help them throughout their careers as they engage in professional learning. These activities can contribute to the development of Personal Learning Environments (PLEs; Dabbagh & Kitsantas, 2012, 2013), which promote three levels of self-regulated learning in Internet-based settings (personal information management, social interaction, and finally aggregate information management). Dabbagh & Kitsantas (2012) view PLEs as a bridge between formal and informal learning, noting that learners may need instructor assistance to master activities at each level.

The social component of social bookmarking is just as important as the knowledge and content components, but should be approached with appropriate concern for student comfort. Although Dabbagh and Kitsantas (2013) indicate that social networking sites can support the development of PLEs, when their use is at least partly instructor-driven rather than informal and learner-initiated, privacy concerns may arise. Learning is a vulnerable activity, and learning on a public stage such as the Internet can be disconcerting for some learners. Instructors can help by setting constraints. For example, most social bookmarking tools allow interactions to occur in private group spaces. Group spaces with restricted membership protect the students’ privacy while engaged in the learning process (Dennen, 2015). Additionally, some students experience discomfort when an instructor adopts popular social networking tools used in other contexts, leading to context collapse (Dennen & Burner, 2017; Jones, Blackey, Fitzgibbon, & Chew, 2010). By using groups rather than public spaces and by using activity-focused collaborative tools rather than popular social networks, instructors can avoid some of the anxiety that can occur when students are asked to post to the Internet at large or use personal social network accounts to connect to instructors and peers.

Finding a suitable technology space for social bookmarking is not the only instructional design-related issue to consider. When students work collaboratively to bookmark, tag, and annotate items, another concern is how much structure to provide. Structure can be

provided in various areas. One area is technology training, and common wisdom along with a review of social bookmarking research (Novak, Razzouk, & Johnson, 2012) suggests that some formal preparation for using a new tool would be a necessary part of a social bookmarking unit. Another way that structure can be provided is within the tagging system. One option is to provide a tagging dictionary, and the other is to allow freestyle tagging. Freestyle systems are attractive because they challenge learners to mine through their shared materials carefully to come up with meaningful classifications. One of the disadvantages of freestyle systems is the likelihood of synonymy, or multiple highly related tags (Golder & Huberman, 2006), and another is the dispersion of tags. However, in a study of graduate students, Im and Dennen (2013) found that during a six-week graduate level course a coherent tagging system began to emerge toward the end. Similarly, expert systems have been found to evolve as they continuously engage in tagging (Lin & Chen, 2012; Panke & Gaiser, 2009). In a class setting, instructors may wish to constrain tagging so it is relevant and topical or, if the activity will be prolonged and somewhat open-ended, they may choose to allow an emergent system to develop.

Like tagging, annotation can be supported. In one study, prompt-based annotation was found to have benefits in terms of both learning and self-efficacy (Sung, Hwang, Liu, & Chiu, 2014). Annotations also can be considered the precursor to discussion. In another study, annotations were found to support robust interactions among students, even exceeding those fostered in a more traditional discussion forum (Sun & Gao, 2017). Instructors who require social annotations need to determine what students should include and how they should interact.

The purpose of this paper is to describe the design of an instructional unit using Diigo (www.diigo.com), a social bookmarking tool, and to share the formative evaluation results from the first semester of the unit's implementation. The questions that guided the formative evaluation process were:

1. What did students like about the Diigo unit? What did they dislike?
2. How effectively were students able to complete the Diigo unit?
3. What parts of the Diigo unit worked best and what parts should be changed?

Although these questions are focused on improving an existing learning unit, we believe that both the description of the unit design and the answers to these evaluation questions will be useful to others who seek to use social bookmarking to support student-content and student-student learning interactions.

Course Context

The Diigo unit was developed for students in a required technology course for pre-service teachers at a large public university. During this course, students learn to use a variety of software programs to perform teacher-oriented tasks (e.g., create a newsletter in a word processor and manipulate data in a spreadsheet). However, not all course objectives are focused on learning software. Additional course objectives address cognitive aspects of

technology integration, including intellectual property guidelines and assistive technologies. These course objectives have historically been given lesser priority within the course as students focus on developing software skills, however the course instructional team equally values them.

Students enrolled in the course are typically freshmen and sophomores who intend to be education majors, although 20-30% of the students enroll in the course to fulfill a general computing requirement and are not education majors. Each semester there are six sections of the course, taught by graduate student instructors using a common syllabus and assignments. Classes meet once a week for three hours in a computer lab.

Diigo Unit Design

The Diigo unit was designed by the supervising faculty member and two course instructors to address two course objectives. First, it provided students with the opportunity to learn an additional instructional technology. Second, Diigo offered a technology-based platform through which students might engage in substantive interaction with both course content (shared web artifacts) and peers (shared annotations). Essentially, the unit supported student engagement with scholarship about technology integration while simultaneously requiring students to learn a new tool with previously unfamiliar features such as tagging and annotating. Similar to Deng, Li, and Lu (2017), our purpose was to have students both collecting, tagging, and sharing texts and engaging in discussion about the texts. We also hoped that they would build community through this unit.

Students were taught how to use Diigo across multiple lessons and were graded based on their participation. Each class session was worth one point, and students earned the point by posting all of the items (e.g., articles, descriptions, tags, comments) specified in the day’s lesson. Table 1 provides information about the Diigo features used and topics addressed each week of the unit.

Table 1. Features and topics by week

Week	1	2	3	4	5
Course Concept	Academic Software	Web 2.0	Productivity Tools	Assistive Technology	Professional Development
Bookmark	x	x	x	x	x
Tag	x	x	x	x	x
Describe	x	x	x	x	x
Highlight		x	x	x	x
Page Comment		x	x	x	x

Peer Comment	x	x	x	x
Topics		x	x	x

The first three weeks of the unit were focused on developing Diigo skills while also engaging with technology integration topics (i.e., articles and websites). During the first lesson, students set up accounts and were introduced to basic Diigo skills. They searched for websites related to the week’s course topic, bookmarked high quality sites, and tagged the sites for easy searching. In addition, students added a description of the shared site, using a bookmarking feature. Because Diigo is social, students could see peer bookmarks next to their own, and they collectively created a bank of resources. Instructors allocated time for students to view this resource bank. During the second lesson, students learned the annotation features, namely highlighting and commenting directly on a web page. Then, during the third lesson, instructors introduced topics. Topics is a discussion forum through which students can comment. Topics differ from comments in that they are not anchored to a specific bookmark, but rather promote general discussion. In this instance, the forum was set up with prompts to guide the students.

During the fourth and fifth lessons, students applied the previously learned Diigo skills to new weekly concepts. With all tools at the students’ disposal, the last three lessons followed this sequence: (1) discuss the week’s concept via topics, (2) bookmark, tag, and describe a high-quality site related to the concept, (3) highlight and comment on the webpage, and (4) view peer bookmarks and comment on their annotations.

Method

This study was conducted with the approval of the university’s Institutional Review Board. The participants were drawn from among the ninety-nine students enrolled across six sections of the course, 83 of whom agreed to participate and 78 of whom completed the survey.

The study used a formative evaluation approach to collect data about the learning unit. Data collection consisted of archives of student work on Diigo, student reflection papers, and surveying students. The Diigo archives allowed us to determine whether students were completing the weekly activities as expected and the depth to which they engaged with the content and with each other. The reflection papers, which were about the course experience and the students’ professional development more broadly, sometimes included student impressions of the Diigo unit. The survey asked students about priori experience with Diigo or other social bookmarking tools and asked them to provide comments about their initial impressions of the tool and the learning unit, their ending impressions of the tool and unit, and at ideas they had for improving the unit. Additionally, course instructors offered their observations and reflections on the unit. Data analysis focused on identifying successes (ideal content and interactions) and failures (insufficient or inappropriate content and interaction) within the class archives, and triangulating these data with student survey data and instructor observations.

Findings

Prior to this course, none of the students had used or were familiar with Diigo. In one course section, two of the students had prior experience with other social bookmarking tools. For the remaining 76 students who responded to the survey, social bookmarking was an entirely new concept.

Initial Impressions

When asked about initial impressions of Diigo, student responses varied. Some were neutral, waiting to see what would happen in their class. Others were a bit apprehensive or uncertain, such as the student who wrote, “I did not understand Diigo at first because I had never heard of it before. I thought it was a little confusing and I didn't know why we would use it.” Still others explained that they were curious, in addition to being a bit skeptical of something new. In that vein, one student stated, “I had not ever used such sources, so I was interested to find out about them. I did think it was a little pointless through the beginning of the semester.”

Learning Process

In general, the learning process went smoothly. Students were able to set up Diigo accounts, learn how to use Diigo's various features, and complete the required activities within the allotted class time. Students primarily followed the prompts and directions provided to them. They built their skills across each of the first three activities. Tagging and annotations were activity-specific because each of the five weekly activities had different content. This was a design limitation in terms of developing an emergent tag system and fostering rich discussion.

One of the six instructors indicated that students developed Diigo skills readily, but were less inclined to view their peer's bookmarks and annotations unless specifically directed to do so. She reported she liked how students delved deeper into the course concepts through searching and annotating, but wished they had interacted more with each other. Once the topics feature was added to the lesson, student bookmarks better aligned with the weekly concepts. Other instructors shared similar feedback, and suggested that minor adjustments to how the unit was presented to students would further strengthen it.

However, not all students were unaware of the potential power of collaborative bookmarks and annotations. For example, one student reflected as follows about the value of using Diigo, both individually and collaboratively:

Many times when someone might read an article the first time they do not catch everything it is trying to say and having the ability to be able to make comments and highlight key things as you read can be very useful. If you share your notes and highlights with others it could be even more beneficial for them since they might not have caught everything you did. [Reflection paper]

Another student, who commented that Diigo was inefficient, suggested that students were considering each other's contributions to the Diigo group even if they were not commenting or directly interacting:

Choosing which articles to bookmark was difficult because you wanted to find new and relevant articles, that didn't repeat or overlap with articles your classmates already saved. [Reflection paper]

This student's perception of inefficiency seemed to stem from the concept of article as mediator of student interaction. In other words, student felt the article was a barrier to interaction rather than the focus of or impetus for interaction. Additionally, it seems worth noting that students in this class also were required to use Twitter and maintain blogs, and both activities occurred with similarly low levels of peer interaction.

Ending Impressions: Positive

At the end of the term, most students had a favorable impression of Diigo. Seventy-two students (92.3%) felt that tagging had been a meaningful activity, and 65 (83.3%) found annotations meaningful. Sample survey comments from students include:

My first assumptions about the program were correct. It was easy to use, and I can see myself using the program in the rest of my college, as well as the start of my professional career.

Diigo was a fun program to use in this class. My classmates and I shared information and articles very fast and easy. I also liked how you can even add comments or suggestions with a group.

Now that I have used Diigo a good amount, I really like it. I think it is incredibly useful and helpful. I actually started using it for other classes this semester, not just (this course) and it has helped me a lot. I think Diigo is something more people should know about and use.

I quite enjoy Diigo because it's easy to keep track of tags, and the hashtags/tagging for Diigo is so helpful. It's also very useful that we can add a brief description of what we're saving so that it's not just dozens of randomly saved websites and URL's. We can actually look at and read what it is that we're saving and it just makes it so much easier to go back and read it or find the saved website or page.

Across these four responses, which are representative of many others, two main themes emerge. First, after receiving instruction and having practice opportunities, most students found Diigo easy to use. Second, they saw the value in tagging and annotating bookmarks. Of course, Diigo is not the only tool with a digital annotation feature, but this unit represented the first time that most of these students had been exposed to these concepts.

Another feature that several students noted was that Diigo could help them work toward a paperless classroom by allowing them to annotate on their articles. For example, one student wrote:

I feel as if I appreciate Diigo more so for the annotating online articles and websites more than I appreciate the social bookmarking aspect. The annotating seems more relevant and could make a classroom significantly more paperless.

It makes sense that these students would value a tool that helps them use less paper. Informally, we have noted a trend toward undergraduate students in this class being reticent to print documents. This somewhat reflects increasing charges for printing on campus and a preference for accessing documents on smartphones and tablets.

Ending Impressions: Critical

There also were students who did not like using Diigo. Eleven students (14.1%) provided open-ended comments that were critical of Diigo. Students who did not like using Diigo expressed one of two sentiments. First, there were 9 students (11.5%) who struggled to make Diigo work. These students were not necessarily opposed to the concept of social bookmarking, but they did not feel that Diigo was an easy to use tool. Some described stability problems (e.g., the browser window crashed), whereas others described interface-related issues (e.g., it was confusing to navigate, and they tired of launching the toolbar each time they entered the lab). These comments came from one course section, in which only one student indicated a positive impression of Diigo. The issues are related to the use of lab computers with individual log ins and, while there was a workaround solution to the problem, it appears that their instructor did not share that solution with the students. This section, which had a small enrollment, stood out in contrast to the others because the majority of the comments about the Diigo were negative and students focused on technology issues. One-way ANOVAs showed significant differences ($p < 0.05$) between this course section and four of the other five sections regarding the meaningfulness of the activity and the desire to use Diigo again; the fifth section, while not significantly different from this section, also was not significantly different from the others. We believe that this section's experience reflects a combination of unique technical challenges that arose in the computer lab and instructor enthusiasm and preparation for the unit.

The other two students who expressed negative sentiments about using Diigo did not have problems with the browser or interface, but rather felt that it was an overly complex tool for the task of bookmarking. These two students wrote that there were too many steps in the process and it took too long to bookmark an item. One student qualified the comment, adding "I enjoyed learning about it and I can see the use for it ... [I] honestly have no reason for [using] it currently." comments suggest that these students did not fully understand or embrace the overall purpose of the unit, which was to engage in social and not individual bookmarking.

This sentiment somewhat echoed a comment in a reflection paper from a student who offered a somewhat conflicted view of Diigo and the unit:

If I am ever in a situation where I need to annotate a website with a group I will use it, but only if it is absolutely necessary. I learned a lot about education technology through Diigo because all of the websites we annotated were about software or hardware used in the classroom. The most useful thing about Diigo is the ability to add comments to other group member's annotations. The sites we chose to bookmark are all related to education technology. I think the reason Diigo was unsuccessful in my eyes is because it was very hard to figure out and get used to compared to Twitter and WordPress. [Reflection paper]

This student's reflection on using Diigo was particularly interesting for two reasons: because they compared Diigo to the other social media tools used in the class, and because they noted that the unit led them to learn a lot about course concepts by pushing them to engage with online content resources. It is not clear from the student's reflection if the difficulty related to using Diigo was interface-based or more conceptual, but it is worth considering that social bookmarking is more of a niche activity than blogging or microblogging, and students in this course were already conceptually familiar with Twitter and WordPress/blogs and in many cases were already Twitter users.

Three other students who had positive impressions of Diigo in general provided additional insight into another potential barrier for the Diigo unit, namely a lack of understanding of the overall purpose of the unit and its various activities. One of these students stated, "I think that [Diigo] was over taught. We really didn't need 5+ weeks of instruction on it." Another wrote, "It seemed really repetitive each week with no true meaning. Social bookmarking could be beneficial, but I feel the Diigo assignments could have been combined." It seems likely that these student perceived the unit as being entirely about learning how to use the tool (the first learning objective), and overlooked the second learning objective that focused on discussion of technology integration scholarship. This tool orientation has been an issue that instructors have struggled with across all units in this course. Students enroll to fulfill a university computing requirement, and thus believe that the course will be focused on using hardware and software. These students have been resistant to attempt to work in conceptual topics, whether those topics are related to learning design, information design, or technology integration in education.

There also were a handful of students who had a positive experience using Diigo but who nonetheless indicated no desire for further use of Diigo. Per the survey, 20 students (25.6%) did not feel that they would have reason to use Diigo individually in the future, and 26 students (33.3 %) did not feel that they would use it collaboratively. These numbers include both students who had positive and negative impressions of Diigo overall. The students who had a positive Diigo experience but who felt they would not use it again commented that Diigo had more features than they needed. For example, one student noted, "If I want to bookmark, then I will just do it normally." The discrepancy

between individual and collaborative use is interesting, particularly since student comments about Diigo seemed to focus more on whether or not the tool could help them in their individual knowledge pursuits rather than whether it would help them participate in networked knowledge activities. To that latter point, the degree to which students value networked knowledge activities is uncertain.

Discussion

Returning to our research questions, many students liked the bookmarking and annotation features of Diigo, and felt that they would use it again. Those who liked it embraced the idea that they could use it to support paperless work and to have organized bookmarks, and it was the bookmarking and annotating part of the unit that worked best. The social element was not robustly executed and seemed lost on some students. This finding mirrors other studies in which students were found to focus on the research and bookmarking component of Diigo activities rather than the communal part (ElShaer, Calabrese, Casanova, & Huet, 2016) and academic researchers were found to prefer using social bookmarking tools for personal rather than collaborative purposes (Du, Chu, Gorman, & Siu, 2014). Our biggest area for improvement pertains to emphasizing and encouraging the collaborative parts of Diigo use, although perhaps that element is not as important as we believe to support student learning; a prior study suggested that greater participation is not tied to perceived learning gains (de Carvalho, Furtado, & Furtado, 2015). Nonetheless, this was an area where the unit was not as well-designed and executed as it might be.

Students did not comment on any inefficiencies or redundancies that occurred within the communal tagging system. These issues are common in user-created tagging systems. However, since students seemed to focus on Diigo as more of an individual than collaborative activity, they may not have been heavily concerned with the usability of peer tags and ability to efficiently search the entire class-generated knowledge base via tags. Still, we believe that learning to create and apply collaborative classification systems is an important information literacy skill, even as computer scientists are steadily refining automated semantic tagging systems (Patrik, Zhang, Sevillano & Izquierdo, 2013). To facilitate this process and push students to pay attention to each others' tags and collaboratively refine the class-generated tag dictionary, future iterations of the unit will be constructed so that students are required to have greater interdependence.

Students did not experience any serious impediments to completing the unit except for the one class that had technological difficulties and grew frustrated about needing to log in and launch the toolbar during each class. Diigo is optimized for use on a personal computer. It is a browser-based tool, which poses challenges for personalization in a lab setting. Others have found this latter point to be a disadvantage of the tool as well (Estellés, del Moral, & González, 2010), and devoting time to technology training has been deemed important (Novak, Razzouk, & Johnson, 2012). We found a work-around solution for our students, but it based on the comments from these students at least one section did not receive instruction about the solution. This class section's experience supports the idea that instructors need to be well prepared to guide students through using

Diigo in a lab setting. Prior experience with Diigo on a personally owned computer, which all course instructors had, will not sufficiently prepare an instructor to guide students through effective use on shared computers.

Conclusion

The learning opportunities provided by social bookmarking are evident in this formative evaluation study, although it is clear that technological difficulties and lack of understanding about the unit's purpose impeded learning for some students. These remain issues to address in future iterations of the Diigo unit. Some of the awkwardness of the Diigo interface is beyond our control, but we can prepare instructors and students for using Diigo through better training and performance support.

The larger challenge, in our view, is helping students fully realize the learning objectives and not get lost in the "buttonology" of tool use. To fully engage in the learning experience, students may need redirection in two areas: (1) from learning a tool to engaging with scholarly artifacts and learning resources related to technology integration, and (2) from individual resource interaction to social resource interactions. Three solutions are proposed. First, by articulating objectives clearly, and reiterating them each week, we can heighten student awareness of the unit's purpose. Second, instructors can provide specific behavioral steps and models for how to view and respond to peer artifacts with the explicit goal of developing social knowledge. Third, students can be asked to reflect weekly, whether in writing or through class discussion, about what they learned *through* the tool and *with* their peers about the current topic. Instructors can provide brief feedback to affirm the appropriate perspective or scaffold development of this perspective. In this way, the instructor guides student perspectives toward the conceptual target. Collectively, we believe these solutions will help strengthen the effectiveness of the social bookmarking unit.

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