
Gameplay, Visualization, and Collaboration in RefScape, a Bibliographic Management Tool

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Introduction

In his work on the scholarly primitives constituting humanities scholarship, John Unsworth (2000) identified “discovering” and “annotating” as two of the first processes undertaken by humanities researchers (para. 3). These initial acts of information discovery and assessment are ideal areas for collaboration; long before there were computers or notions of shared credit, faculty members sent – and continue to send – their research assistants to find resources and create annotated bibliographies of their results. Modern bibliographic management tools can make the collection, sharing, and use of references much easier, and many are specifically designed to support collaboration; however, making collaboration possible and actually encouraging collaboration are two very different functions. Our personal experiences and anecdotal evidence have shown that while projects start out with the intention to use collaborative tools, such as wikis or communal workspaces, many have difficulty sustaining their usage over time (Gutwin, Greenberg, Blum, Dyck, Tee, & McEwan, 2008). Furthermore, in cases where teams do persist in using this collaborative tool, they are faced with the additional challenge of keeping track of large numbers of resources, as well as balancing the workload between contributors.

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With these challenges in mind, we created RefScape in order to visualize bibliographic resources among multiple researchers. The prototype we have developed is a browser-based plug-in that is compatible with Zotero, a program designed to collect and organize bibliographic resources. Zotero is a wonderful bibliographic management tool in its own right; free, lightweight, and multiplatform, it provides a means for a group of researchers to collect and share their research materials. Building upon the strengths of Zotero, our group is using video-game strategies and mapping tools to create a digital space where researchers may more easily:

- a. collect, organize, annotate, link and tag resources;
- b. visualize and connect resources with similar content;
- c. connect their own material to other users' references;
- d. compete and/or co-operate with other researchers/players to expand and advance their research area through a game-based approach.

The reasoning behind this approach is that the increased interaction and level of enjoyment that users experience as part of the gameplay will result in more motivated, sustainable, and higher quality collaboration, and that the game itself will serve to organize the material, making it more usable and memorable for the researchers.

Although Zotero offers the ability to link and annotate resources, our group has found it difficult to sustain the effort of using the program in the long-term after an initial set-up. One reason for this failed adoption might be that, as collections grow, it becomes increasingly difficult to keep track of the current entries in the database, and thus researchers may unknowingly add the same items, resulting in redundancy and confusion. Foley and Smeaton's (2010) studies on the efficiency of information retrieval systems have shown that a key criterion to developing an effective system is minimizing such redundancy. One way to accomplish this would be to divide the tasks among researchers, but Foley and Smeaton (2010) have demonstrated that this approach is virtually impossible for modern research tasks where users are rapidly querying, viewing, and assessing the contents of documents. This multi-tasking often blurs the boundaries between different research stages and topics, which makes it impossible to isolate individually assignable research subtasks. This concept has also been explored by Gutwin et al. (2008), who found that "a rich awareness of other people in the group and their work environments" (p. 1412) was fundamental to facilitating informal collaboration. To this end, the RefScape system provides researchers with a visual interface for easily sharing knowledge and tracking progress so they can fully benefit from their collaborators' collective expertise, rather than being encumbered by it.

Motivating and sustaining collaboration

There is a long history of research into what motivates people to perform certain actions, especially with an eye towards enhancing productivity and/or academic performance. This research is being used to help build systems that encourage people to work together as well as, in a closely connected area, to explain why people start and keep playing certain types of video games.

There are two basic sources of motivation: extrinsic motivation comes from external sources, such as rewards and punishments; and intrinsic motivation, which stems from the activity itself being perceived as a reward. Not surprisingly, intrinsically motivated actions tend to be perceived by the user as more enjoyable and thus see higher levels of sustainability (Ryan, Sheldon, Kasser & Deci, 1996). Through the process of internalization, however, “individuals transform regulation that was initially regulated by external factors into personally endorsed ones” (Lafrèniere, Verner-Filion & Vallerand, 2012, p. 827). There are four stages to internalization (Ryan et al., 1996):

1. External regulation: doing something because one is required to
2. Introjected regulation: doing something out of guilt or to avoid shame
3. Identified regulation: doing something because one has consciously accepted its value as meaningful
4. Integrated regulation: doing something because it is or has become important to you personally

For example, a student begins researching a subject because they are required to for a class. They persist at the task to avoid the shame of failing the class. Through the process of writing the paper, they learn that acquiring research skills is effective preparation for their future career. Finally, they undertake a research project because of personal interest in the area of study.

As many instructors and teaching assistants can readily testify, this process is far from guaranteed, and for many students, course-related tasks are undertaken only at the first or second levels of motivation. Without extrinsic motivation, the person will cease the activity: the student who never reads fiction except when required to for a class. Self-Determination Theory (SDT) helps explain why some tasks become intrinsically motivated, while others do not. As Wang, Khoo, Woon Chia Liu and Divaharan (2008) state,

SDT is an organismic theory of motivation that accounts for psychological needs and motives. Psychological needs include autonomy, competence, and relatedness. Autonomy is the ownership of one’s behavior. Competence the ability to produce desired outcomes and to experience mastery and effectiveness. Relatedness is the feeling of being connected with others and of caring for and being cared for by others. These three needs are assumed to be innate in SDT and are essential for people’s survival, growth, and integrity. If these three needs are satisfied, growth and development results, and intrinsic motivation for the task increases. When the three needs are not met, negative emotions such as anxiety and anger may result, and intrinsic motivation for the task is undermined. (p. 40; see also Ryan et al., 1996).

Thus, facilitating autonomy, competence, and relatedness is the goal for anyone seeking to increase the motivation of another. Nicholas Yee (2006) found these factors to be central to why players devote large amounts of time to video games; primary motivators for play included interacting with other gamers (i.e., relatedness) and overcoming challenges (i.e., competence). Understanding how games motivate people to perform (and keep performing) certain tasks might help designers of collaborative

systems to create environments that not only facilitate, but also encourage and sustain collaboration. This could in turn help to address the problem, identified by Gutwin et al. (2008) and others, that groups tend not to integrate collaborative tools into their long-term practices.

Gaming a bibliography

Game learning has been the subject of several studies in library and information science investigating whether it is beneficial to pedagogy and exploring its potential positive contribution to educational tools. Gaming can be effective in learning and teaching environments, but little attention has been given to the potential benefits of “gamification” in collaborative research. Additional research has also been conducted on how games can motivate learning behaviours, such as in Lafrèniere et al. (2013) and Ryan et al. (1996). With the intention of exploring the potential advantages of using gameplay as part of a reference management workflow, our team developed RefScape as a prototype, uniting a bibliographic management tool with a “gamified” experience. Our main goals are to increase users’ interaction, motivation, and level of enjoyment in the research process through gameplay. Our prototype leverages Zotero’s capabilities for the shared collection and annotation of research materials to offer a digital space where users can visualize their bibliographic database on the screen, facilitating information location, retrieval, and possibly recall.

With RefScape we are leveraging existing research behaviour to motivate users and to enhance their connection with other team members. We aim to help those users with a low level of motivation, but believe that the key is to appeal to researchers’ personal competitive behaviour so that they are encouraged to contribute consistently to the research workflow (Ryan, et al., 1996). One way to do so is to make each user’s overall contribution visible to the entire group. In this way, researchers can check the group’s progress on the screen and be more motivated to add references to the system. This opens up the possibility for research to become a self-rewarding activity, as users can literally see their own research growing through RefScape, while keeping tangible track of their group’s research results.

Although RefScape’s ability to view group contributions at a glance is useful for monitoring and supervision, its real benefit is that users are decentralized. One of the most important features of RefScape is its lack of pre-established hierarchies among users; all members of a group have equal access to each other’s work, so one can be both contributor and supervisor at the same time. This enhances the flexibility of the research workflow because RefScape can be simultaneously used by different researchers, and the results collected can be shared among the group. In addition, as each team member can visualize the results of the other users’ searches, annotations, and assessments on the screen, researchers are constantly informed of progress, minimizing redundancy. RefScape provides the means for members of the group to stay abreast of their collaborators’ work, and increase their knowledge and efficiency in communicating research results. The challenge behind this approach is to make research more productive, while keeping it enjoyable, a word rarely associated with academic tasks.

RefScape is both competitive and collaborative. Aside from promoting the “healthy competition” that comes from trying to keep up with group members, Refscape has been designed as a motivational tool that uses competition to achieve collaboration among users through the application of gaming strategies. The points system we have in mind rewards users for participation in the group and allows them to compete with each other. Common tasks, such as finding and tagging articles, are worth a base amount of points. High-value activities, such as connecting articles together, reading articles, and commenting on articles are worth more points. Sources that are tagged as useful and connected to many other articles generate points for the owner if others make connections. This way, research that becomes important for the group is highly rewarded in the game environment.

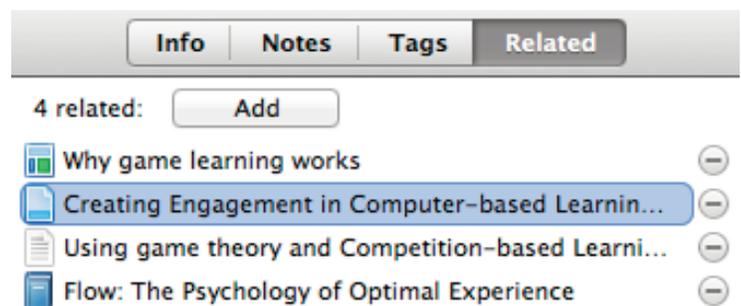
We have been considering conditions for “winning the game,” but, pending play-testing, we will first be implementing a system without a set end point so as to better reflect the realities of research. Currently there is no “winner” beyond the status of having the most points. Our hope is that long before the players worry about who has won, they will come to see the other benefits of using the collaborative tool and will have integrated it into their collective processes. As we move forward, we plan to prototype different games and visualizations that make use of this scoring system and help make the visual interface a more active part of the group’s workflow.

In developing our prototype, we are encouraged by the success of another Zotero-based bibliography game, Bibliobouts. Designed to teach students fundamental research skills, Bibliobouts enabled students to compete against each other at finding and assessing research sources. Not only did the results of the game testing period show that players cited more sources in their research papers than nonplayers, they also showed that the players themselves felt that the game motivated their own research (Markey, Rieh, Rosenberg, Swanson, Peters, Wong & Packard, 2006). Furthermore, even though the gameplay was competitive, players appreciated that the game allowed them to work collaboratively and to learn from the research experience of others. Indeed, the only downfall to Bibliobouts seems to be that it required the support of outside agencies, such as the Zotero developers, and for instructors to set up new matches, a problem we are avoiding by designing our game as a Zotero plugin, which is flexible, easy to maintain, and open-source. And while Bibliobouts was designed to teach research skills to students, we feel an open-ended game-based system will benefit and motivate experienced scholars as well as students.

Interface

The visualization tools currently used as Zotero plug-ins are time-based or analytical tools. RefScape works with user-defined data and interactions with Zotero. In the alpha prototype, we have built a visual interface in Firefox with D3 (Data Driven Documents) that uses data from a group Zotero library. Each member of the group is labeled by colour and accumulates points by performing common research tasks in Zotero. All group activity is updated to RefScape,

Figure 1: Related items in Zotero



including references, annotation, and links made in Zotero standalone or through the online interface.

Figure 2: Related items in RefScape

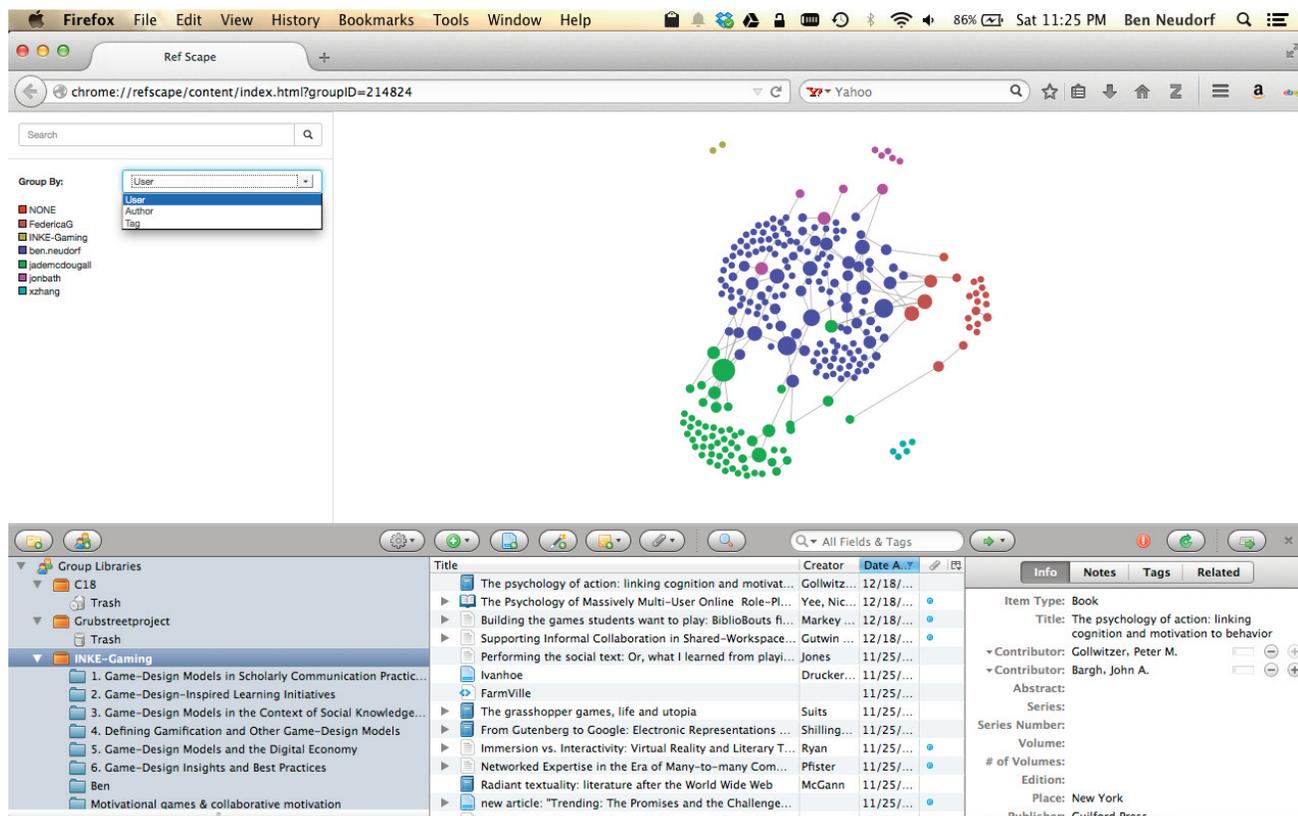


Figure 1 shows the related items tab in Zotero. Viewing and creating related items in Zotero is tedious. The item and the “related” tab must both be selected, and there is no way to see groups of related articles.

Figure 2 shows related items in RefScape. Each dot corresponds to an entry in the Zotero database and each color is associated with a different member, so that it is easy to keep track of the number of resources each researcher has contributed. One of the key functions of the prototype is to visualize intuitively the bibliographic connections created through Zotero on the screen. In our interface, the relationships are all visible at once. The grey lines connecting each node are links, which can be created by clicking on the nodes in RefScape. As a source acquires more connections with other references, it becomes a “hot spot” and its dot becomes bigger, drawing users’ attention. The Zotero interface is still accessible and can be used as per usual.

The RefScape interface enhances the experience of working with a collective reference database by making both overall progress and progress relative to other members in the group instantly visible. Linking and “related” connections are easier to make, and it becomes possible to see connections between group members. Whether group members have been assigned different tasks or are working on the same topic, these

links and connections are vital to the development of the research project, especially in the initial stages of gathering and vetting sources.

Next Steps

RefScape applies videogame strategies and theories of motivation to collaborative research in order to increase researchers' motivation and use of collaborative tools, regardless of the stage of their career. It has been a valuable addition to our team's workflow, and has helped us manage our project, to make new connections, and to motivate each other through competition and collaboration. We will formally assess the value of RefScape in research environments by incorporating it into classrooms this fall. Our user testing will determine whether it improves access to resources, user participation and collaboration, or the quality of research in group projects. RefScape contributes a dynamic visual interface to the already valuable functionality of Zotero, and promotes productivity and motivation in collaborative research environments.

In the current stage of development, each reference has a fixed position, but it changes every time the visualization is loaded. In future iterations, we hope to have a fixed location for each node. Spatial games, maps, and views with fixed, user-defined locations for reference nodes will allow us to assess how well RefScape aids memory, retrieval, and analysis of articles. This draws on the "method of loci," which works by associating pieces of information with real or imaginary spaces, and has a long history of effectiveness for memory recall.

In the next phase of development, we also plan to incorporate more of Zotero's tools into Refscape's interface, and prototype different game possibilities for the RefScape environment. We are expanding on the tagging and linking abilities of the current prototype by adding the ability to mark references as useful or not useful and prototyping alternative ways to visualize the results by group member, tags, author, and other categories. We also want to add more complex games that use data from Zotero. Some possibilities are mini-games, a long-term strategy game, memory games, or games that help explore the research through keywords or content, and achievements or trophies to track progress. Some of these elements may work together, so that achievements and progress earned for short tasks help progress in a long-term game.

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