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This paper reports on the design and evaluation of a prototype of the History Lab Web application, a technology enhanced learning project that aims to help undergraduate students reason about historical concepts and written argumentation. Motivations for the project are presented along with a review of pertinent literature. User research consisted of a focus group with graduate students in a University of North Carolina at Chapel Hill history pedagogy course and contextual inquiry interviews with a group of students from an undergraduate history course, which gave insight into the goals, skills, and strategies expert and novice historians use and the differences between those groups' methods. Moderated formative usability evaluation was conducted with another group of undergraduates enrolled in the same course. A paper prototype was used to measure the effectiveness, efficiency, and satisfaction of their experience. Wireframes and interaction diagrams of the prototype are also presented.

Headings:

Human-computer interaction

Educational technology

Interactive multimedia

Systems design

Web design

User interfaces (computer systems)

HISTORY LAB:
DESIGNING AND EVALUATING AN APPLICATION FOR
LEARNING HISTORICAL REASONING

by
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Motivation

I. Purpose

The purpose of this project was to conduct a needs assessment and user research, design the History Lab (HL) user interface, and to evaluate its usability with a group of undergraduate history students. Needs assessment and user research for HL consisted of a focus group of expert historians aimed at clarifying the skills and strategies they use in order to conduct historical research with the purpose of making HL an interface that teaches and enables such behaviors. Contextual inquiry interviews with undergraduate history students, the main user group for HL, were the next step of the user research process. Interviews were conducted so as to establish that user group's practices and goals when engaging with historical materials and to better understand the gap between their novice practices and those of the expert historians. Moderated usability evaluation was then conducted using a paper prototype with another set of undergraduate history students as participants, using realistic tasks and historical documents. The goal of these tests was to gather qualitative data on the effectiveness, efficiency, and satisfaction – the metrics identified in the ISO 9241 usability standard – with which users interact with the interface (ISO, 1998). All of this was aimed at designing an interface that will help students cultivate the disciplinary stance of the historian: to evaluate the reliability of sources; identify an author's arguments; place the author, events, ideas, and arguments in the context of broader historical events; make connection between a variety of sources; and draw conclusions from historical evidence (Shields, 2012).

II. Research Questions

1. How can a Web application help undergraduates develop the historical research skills related to gathering documentary evidence and producing written argumentation?
2. What types of software and interface features do expert and novice historians use to conduct historical research?
3. How can usability evaluation ensure that HL is usable and effective at developing historical research skills?

III. Literature Review

Falling as it does at the intersection of historical pedagogy, technology-enhanced learning (TEL), human-computer interaction, and digital humanities, there is a wide variety of literature pertinent to the HL project. Below, I will review a small selection of literature that falls broadly into the areas of HCI, historical pedagogy, and the interdisciplinary subject of TEL. The primary research question for this part of the HL project is, “How can a Web application help undergraduates develop the skills and disciplinary stance of an historian towards documentary evidence and written argumentation?” As such, HL has been designed with an underpinning conception of how historical reasoning happens, “a process in which central facts and concepts are arranged to build an interpretive historical case. Building a case then requires synthesis, hypothesis generation and interpretation” (Van Boxtel & Van Drie, 2004, p. 1-2). Historical reasoning can be further decomposed into six components: the asking of historical questions, contextualization, use of sources, argumentation, use of substantive concepts (approximately the “unique” or “ordinary” described below), and the use of meta-

concepts to describe, compare, and explain historical phenomena (Van Drie & Van Boxtel, 2008).

Of these six components, contextualization, the use of sources, and the organization of information to analyze historical phenomena are those processes with which HL is directly concerned. Contextualization is an especially important problem to be addressed; following Wineburg, Van Boxtel and Van Drie note, “the failure to grasp the nature of historical context is often described as an important source of student misunderstanding” (p. 3). Through its numerous visualization features, chronological context – knowledge of periods, significant events, developments, and how they relate to each other – and narrative context – organizing historical information in a coherent way – are two contextualization mechanisms Van Boxtel and Van Drie identify that HL will support. Van Boxtel and Van Drie’s data show these frames of reference are shared by both expert and novice historians: “Both experts and novices used a chronological-spatial frame of reference and narratives, which they tried to cohere with information in the sources” (p. 8).

The constituent parts of both narratives and chronological-spatial frames of reference are historical concepts; indeed, history can be described accurately as a concept-driven subject (Haenen & Schrijnemakers, 2000, p. 24). Generally speaking, concepts are “dynamically constructed and collectively negotiated meanings; in this context, “historians use concepts as stable subjects to illustrate some process of historical change” (Shaw, 2010, p. 6). In Haenen and Schrijnemakers’s typology, historical concepts can be decomposed into everyday concepts, unique historical concepts, and inclusive historical concepts. Everyday concepts, like “messenger” and “to agree with,”

are not intrinsically historical, but often play a role in learning about the past and in developing historical understanding and inquiry (p. 25). Unique historical concepts are constructs that apply to an entity each of which is the only one to which the name in question applies. Napoleon I is such a unique historical concept, as is the Carolingian Renaissance, since this represents the metaphorical use of a unique concept (“Renaissance”) to refer to another unique concept. Inclusive historical concepts bring together a set of distinct objects, such as “castle,” “king,” or “parliament.”

Shaw (2010) establishes an alternative typology of historical concepts. The first type is ordinary concepts, which use ordinary language to represent the past in a way that can be easily understood by the historian’s audience. “Artist” is such an ordinary concept (p. 8). To all other historical concepts Shaw ascribes the category “colligatory concepts” – colligation, unlike classification, groups *unlike* things together. William Whewell, who coined the term, used the evocative analogy of a pearl necklace to explain colligation: “The pearls are there, but they will not hang together till someone provides the String” (qtd. in Shaw, 2010, p. 10). Subtypes of colligatory historical concepts are characters – for example, Rosa Parks, who was both a person who existed in time and a character in historical narratives about the American civil rights movement – ideal types – “discontinuous entities abstracted away from historical times and places,” such as “chemistry” or “French literature”) – and periods – concepts like “the French Revolution” or “the Renaissance” that are synthetic constructs that are localized in time and space, but discontinuous over space and time (p. 16-20). There is an important theoretical and practical distinction to be made where Haenen and Schrijnemakers, and many others, make none “between grouping like things under a concept (thereby arguing for a

particular theory of likeness) and grouping unlike things under a concept (thereby arguing for a way of seeing those various things as a connected whole)” (Hjørland & Shaw, 2010).

It is beyond the remit of this project to resolve the theoretical and practical tensions outlined here. Rather, the important thing is to note differences in typology and to design the Concept data type and its associated metadata to be flexible enough to cover the classification and colligation of historical concepts. Usefully for the design of metadata for historical concepts, Haenen and Schrijnemakers outline attributes shared by the historical concepts in their typology: a name, an example of the concept (i.e., “Windsor Castle” is an instance of “castle”), attributes that represent the essential features that lead us to put instances into the same category, the acceptable value range of attributes (i.e., the range between “Hearst Castle” and “Windsor Castle”), and a rule that establishes the essential attributes and what connects them (p. 26). However, it should be noted that this is a peculiar property of unique historical concepts: they can never be described exhaustively (p. 27). Even still, these types of concepts and their attributes represent the types of data and metadata HL must support in order to allow users to describe historical concepts as fully as possible.

Viewing and manipulating historical concepts visually – as opposed to or in addition to textually – has been shown to be beneficial in developing a sense of historical context. Studies in educational psychology have shown that “graphical representations can communicate information more effectively than text, because they visuospatially manifest the structural information underlying the text, and reduce readers’ cognitive effort while they are interpreting or capturing the unarticulated message” (Tzeng, 2010,

p. 128). However, “graphic organisers may increase the readers’ focus on only the represented information while decreasing the attention paid to non-represented information...[and] may also limit readers’ abilities to rearrange the presented concept structure to fit with the knowledge organisation that the readers already possess or lead readers to focus more on terms than on suggested associations or the general meaning of the text” (p. 129). These caveats underscore the necessity of supporting both visual and textual modes of representation, and of making it as easy as possible to create new graphical or textual representations of historical concepts.

Historians, expert and novice alike, deploy a number of skills and strategies in analyzing historical concepts and transforming them into written argumentation. These skills and strategies must form a foundation for our approach. In discussing their Sourcing’s Apprentice system, Britt & Aglinskas (2002) suggest the three document-level skills fundamental to historical work are sourcing, contextualization, and corroboration (p. 486). Sourcing – the skill on which the other two rely – is the ability to identify critical features of the document and its author: its relationship to the event described, the author’s level of participation in it, and so on (p. 487).

Contextualization and corroboration between sources make up two basic “investigation strategies” to documentary evidence (Tabak & Reiser, 2008, p. 310). These strategies paired with discipline-specific knowledge make up a disciplinary stance, which “characterizes the performance of established members of a community of practice. It reflects the unwritten rules of a discipline” (p. 310). “Community of practice” implies expert practitioners; Britt and Aglinskas (2002) propose a model of “cognitive apprenticeship” for interfaces designed to help students start becoming part of such a

community (p. 496). Skills and strategies are mapped to UI affordances and interaction design, Tabak and Reiser suggest, through the development of a discipline-specific investigation model. Such a model renders explicit some of the implicit strategies used by experts in a domain. Methods for developing an investigation model include “consulting with subject matter experts, developing pseudo task analyses based on scientific reports, and synthesizing studies of students’ conceptions” (Tabak & Reiser, 2008, p. 311). In designing HL, we gained an understanding of students’ conceptions of their stance to historical documents and strategies through contextual inquiry interviews with undergraduate history students, as described in the User Research section below. A focus group with expert historians (in this case, graduate students) was also conducted in order to develop the investigation model of an historian’s stance. Although the disciplinary stance being tested in Tabak and Reiser (2008) is that of an evolutionary biologist, their conceptual model and methods are generalizable to any discipline. The systems tested in both Britt and Aglinskis (2002) and Tabak and Reiser (2008) showed significant results in helping students develop document-level reading skills and discipline-specific investigation strategies.

That said, technology will not enhance learning per se (Dror, 2008, p. 218). In order to make it more likely that technology will be useful, we must consider “whether the learned material is acquired and encoded in a way that forms long lasting mental representations” (p. 216). To do so, TEL systems must be built on a cognitive understanding of how users learn, which can be broken down into three aspects: acquisition, memory, and impact. These elements of learning are goal-oriented, and the system must be designed to be attuned to the objectives of the learner (p. 218). In setting

out heuristics for the design of instructional systems, Van der Meij and Carroll (1995) suggest a goal- or action-oriented approach as the best way to ensure the system presents and manages information in a way that engages the cognitive activities of learning (p. 245). Further, the interface should be clearly situated in the tasks' domain, which not only provides "a meaningful context for the presentation of information" but, as described above, lends a deeper sense of engagement with a disciplinary stance (p. 247).

Within the UI's task-oriented, domain-specific space, users should be given a large degree of control over the presentation of information and the pace of learning. Even these most basic aspects of control over the interface and the learning process engender a sense of ownership that improves learning "both in terms of achieving the learning objectives and in terms of the learners' positive affect" (Dror, 2008, p. 220-221). By giving users some measure of control over the learning process and clear feedback about their progress, users are challenged to make a commitment to the learning process, which is the most elusive aspect of learning in a TEL environment to create (p. 222). HL will maximize its ability to teach historical research methods by supporting learning as a cognitive process and by being designed as a minimalist instruction environment – one that allows for learners' need for "meaningful activity and sensemaking" in a goal-oriented, domain-specific space (Van der Meij and Carroll, 1995, p. 243).

There is a wide range of interfaces and approaches in TEL. Granic et al. (2004) make the useful distinction between a learning management system and a learning content management system, the latter being defined as an interface that has "capabilities [including] management of either content or learning object, which is provided to the right learner at the right time" (p. 1). HL is envisioned as such a learning content

management system, one that, rather than directly intervening in the learning process by prompting users for answers – as a learning management system might – will enable users to manage and analyze sources and incorporate them into written arguments.

Furthermore, there is a distinction to be made between “traditional e-learning” and the adaptive hypermedia approach to TEL, which is directed toward finding strategies for the personalization of interfaces to a user’s skills and experience. An adaptive hypermedia system is “any hypertext and hypermedia system which reflects some features of the user in a user model and applies this model to adapt various visible aspects of the system to the user” (Mulwa et al., 2010, p. 1). In a literature review of adaptive hypermedia research in TEL, Mulwa et al. find that incorporating research about how users learn and work into the system’s design is an integral part of making interfaces responsive to different types of learners. That said, they found no conclusive evidence to show that allowing for different “learning styles” (verbal, mathematical, kinetic, visual, etc.) in adaptive hypermedia TEL systems benefitted students in a significant way (p. 7). Rather, user models must be built on a solid understanding of users’ goals and the strategies they use to complete the tasks that are to be aided by the system (p. 11).

Although Mulwa et al. (2010) are not clear on best practices for developing user models, the method utilized here is a user-centered design interview technique called contextual inquiry, in which the researcher sits *in situ* with a user and watches how they complete relevant tasks (Beyer & Holtzblatt, 1997; Holtzblatt et al., 2004). Related to think-aloud protocols, contextual inquiry is a quasi-ethnographic method that provides reliable, detailed knowledge of how users actually work and their goals in performing tasks. As one of the less artificial methods for developing user models, it allowed us to

gain an understanding of how undergraduate history students actually interpret documents and begin to integrate them into written arguments. The goal of these interviews, as will be expanded upon below, was to make HL more indicative of how students actually work. One of the heuristics of minimalist instructional design is to respect the integrity of the user's activity: "in some cases, this will mean subordinating the presentation of information or explicit instruction to the continuity of the user's project-oriented activity" (Van der Meij and Carroll, 1995, p. 246). Contextual inquiry sets the stage for the design of the UI to at once respect the integrity of users' activity while enabling them to begin assuming the disciplinary stance of the historian.

Of course, being able to learn historical research methods using HL is incumbent upon the interface being usable. The end goal of this project is thorough user research and a comprehensively researched and designed user interface; development of the application is beyond its remit. As such, usability evaluation of the UI at this stage would most usefully be formative and allow subjects to participate in the design process. The method chosen for usability evaluation here is paper prototyping, most fully explicated in Snyder (2003). The time constraints on this project also played a role in choosing paper prototyping as the appropriate usability testing technique. As Nielsen (2003) notes, "Paper prototyping is one of the fastest and cheapest techniques you can employ in a design process." In addition to these practical values, Snyder also cites early, substantive user feedback, the promotion of iterative development, and the low overhead in terms of skills for facilitators and users as other virtues of paper prototyping (p. 12). In a survey of 172 usability professionals conducted in 2002, 56% of respondents deemed paper prototyping "useful" and 30% called it "essential" (p. 14). However, Snyder also

pragmatically describes the usability issues paper prototyping will and will not likely reveal. Due to the limitations of the medium, usability tests conducted using a paper prototype will not reveal keystroke or mouse errors, issues with rollover or cascading menus, or issues with responsiveness (p. 277-281). Related to the latter, paper prototyping is also not useful for testing issues pertaining to how interfaces respond to being displayed on different devices (“responsive design”). However, paper prototypes are useful for discovering what Snyder terms “depth issues,” that is, “what the interface will do” (p. 272). Depth issues include unclear concepts and terminology, issues with navigation and workflow, as well as problems with interface layout and content (that is, parts of the interface where the user seeks content and makes decisions based on it) (p. 272-275). Given the time and budget constraints of the project and that the goal of usability testing here is to formatively test the UI and iterate on its design, paper prototyping was deemed to be the most appropriate method.

Based on the literature review above, the design and evaluation of HL will be innovative in that it will approach a learning content management system from an adaptive hypermedia perspective. Further, the research component of this project applies a contextual inquiry approach to the design of TEL, which we consider more appropriate as it is a methodology based in systems design rather than in psychology or pedagogy. Combining the investigation model advocated by Tabak and Reiser (2008), the user models suggested by Mulwa et al. (2010) and the method for developing them described in Beyer and Holtzblatt (1997), and the minimalist, learner-focused instructional design of Van der Meij (1995) and Dror (2008) will result in a well-rounded approach to designing a TEL interface. The user-centered design process is “brought home” in that

the paper prototype-based usability testing will allow actual members of HL's main user group evaluate and participate in the design of the UI. This project builds on the literature reviewed by integrating their strengths into one comprehensive approach.

Needs Assessment and User Research

User research for HL was conducted in two stages. The first took the form of a focus group conducted with the graduate students enrolled in the Spring 2013 section of HIST 702, “Introduction to History Education.” The second stage was a series of contextual inquiry interviews with undergraduates enrolled in the Spring 2013 section of HIST 276, “The Modern Middle East.” These events took place as the first two iterations of the interface were being designed. The data from these discussions was used to form a needs assessment of the primary user group for HL, undergraduates enrolled in history courses; to develop personas and scenarios; and to inform design thinking as data was being processed.

I. Focus Group

A. Methods

The goal of the first part of user research and needs assessment was to develop an investigational model for expert historians, or, in more general terms, a sense for the tools and techniques that experienced historians use to conduct historical research. We decided the best way to efficiently gain a sense for the landscape in these areas was to conduct a focus group with a group of expert historians, in this case Ph.D. students in the History Department at the University of North Carolina at Chapel Hill. Focus groups should ideally be pitched somewhere between a meeting and a conversation. As a research method, they have three strengths. The primary strength of focus groups is their interactivity: “participants can compare their views with those of other participants

in the group, rather than simply reporting their views to an interviewer. In this process, group members will make their differences of opinion explicit and will also voice their agreement with others' views" (Wildemuth, 2009, op. 242). This structure mimics the social setting in which people frequently form their opinions and attitudes. Another strength of the method is the efficiency with which focus groups can be used to generate new ideas. The wealth of conceptual, interface, and interaction ideas that resulted from the HL focus group was striking, as will be shown below. The focus group was conducted during the first hour of one of the weekly HIST 702 seminars with the ten Ph.D. students and the instructor, herself a Ph.D. historian, present that evening. The instructor, Dr. Sarah Shields, is an investigator on the HL project, so the focus group sample of subjects was admittedly a convenience sample. Still, given the small, precise user group about which data needed to be captured, it was a sensible sample. To offset this and to capture data about another distinct user group, we followed Wildemuth's advice to combine the data collected from a focus group with other research methods such as in-depth interviews, as will be described below (p. 243). Before the session was carried out, a focus group guide was designed to aid the facilitator. This was required by the Institutional Review Board at the University of North Carolina at Chapel Hill, and followed their rubric for its development. The session was audiotaped for later review and analysis. In keeping with IRB standards, the users' data has been anonymized here and in any records of the session.

B. Results

Figure 1 below shows the investigational model, in effect a process model, derived from both the literature review and the focus group described below. Given that

the focus group was conducted in the earliest design stage, HL's conceptual underpinnings were also a prominent part of the discussion. One question that was returned to repeatedly was, how explicitly pedagogical should HL be? Put another way, how guided should instruction be in the interface? The group decided that the middle ground would be to have the interface afford users the ability to store documents and generate and store metadata about those documents, with a full-text search option to be able to quickly re-find things stored in the database. Another idea that came up frequently was scaffolding: whether the interface should be simplified for inexperienced users, with other features for "power users" that can be utilized as needed. For example, one participant noted, full-text search is only really helpful when there is a large mass of documents which are being indexed. Such a feature might be of more use to an experienced historian working on a project with a larger scope than a student in an introductory level history course writing a paper based on two or three primary sources.

The distinction between the scope of an historical writing project also surfaced in the discussion about how this group of expert users generates a research question. One user made the useful distinction between research questions and historical questions. More experienced historians most frequently are writing about the research questions, whereas undergraduates most frequently write about historical questions in class assignments, the goal of which is to encourage them to practice using historical reasoning. HL, we decided, should support the process of asking both types of questions. Whether generating a research or a historical question, one user said, it is a non-linear process either way. Historiography – the ideological or methodological framework in which the research question is being asked – also plays a more important role in the kinds

of questions experienced historians ask. Freshmen in a 100-level history class are unlikely to be asked to look at an event from a specifically Marxist perspective.

When asked about what tools they use to perform historical research and write about their findings, Microsoft Word and Web browser were cited as the basic tools common to everyone. Several participants also mentioned using some form of citation management software – EndNote, Zotero, or Mendeley were all named – to keep track of their sources and automatically generate citations and a bibliography. Some also used writing software that had more advanced features for arranging large, multi-part documents, like a dissertation. DevonNotes was one such application, as was Scrivener. Evernote was mentioned as a note-taking application that had several helpful features, including the ability to add tags to documents as well as full-text search and OCR (optical character recognition) capabilities for querying documents. One user purported that she knew of no free or inexpensive software that generates timelines well.

In terms of tools to organize ideas when beginning to write a paper, all cited outlines as the most important tool they use. Some use mind maps as well; one described a mind map as an intuitive intermediate step between disorganized materials and a more logically organized outline. When the facilitator mentioned that it might be interesting to have an interface that would take a mind map and turn it into an outline, one participant expressed concern that having the interface automatically generate an outline would be antithetical to the aim of helping students develop such skills themselves. Another participant argued that a mind map would not map directly onto an outline, and having students manually rearrange mind map relationships into an outline would be a good critical thinking exercise.

Organizing materials is a practice many of the participants had thought about extensively. They like interfaces that allow them to keep granular hierarchies of folders. Some reported keeping sources, drafts, and notes in separate physical or digital folders, while others reported using a “pile” system: organizing all the materials about a certain subject in a literal pile or digital folder. Version control of manuscript drafts was another concern these users had, given the scope of projects on which they work.

At the highest level, the discussion returned time and again to what was identified as the three potential purposes of HL: organizing materials, helping students put together an argument in essay form and, at the most abstract level, teaching students how to think critically. Participants dwelled on the last purpose most; at one point one participant asked, if software can teach critical thinking, are history instructors out of a job? Although the general consensus was that this would not be the case, much of the conversation focused on creating digital tools to supplement instruction without creating more work either for the instructor or for students. Asking students to input metadata for documents, for example – deciding a document is a primary or secondary source, who wrote it, when it was written, what historical concepts it touches on – was agreed to be a good way for historical understanding to begin to be developed. Further, visualizations for the development of contextual awareness and argumentation could be beneficial for helping students’ historical understanding.

At one point, one participant asked a point-blank question of the facilitator: why bother developing this application that may have no features that are useful outside of a history class context? Brainstorming on that question, we determined that the potential for visualizing connections between historical concepts in a number of different ways,

and to begin transforming those connections into a written argument, is a good value proposition. Further, said one participant, no one could think of a piece of software that combines all of the features that were discussed as being included in HL. The reduction in cognitive load alone by allowing users to stay in one application to complete several distinct but related tasks is a significant value proposition.

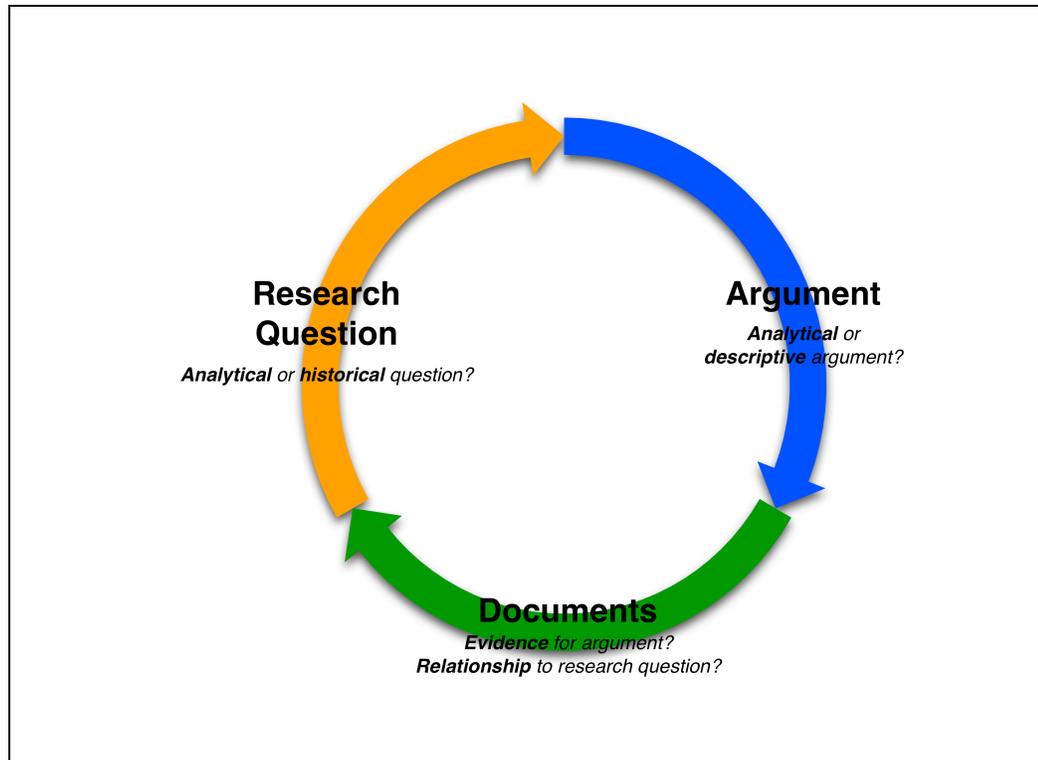


Figure 1. Historical Research Investigational Model.

II. Contextual Inquiry Interviews

A. Methods

The goal of the contextual inquiry interviews was to develop an understanding of the tools and techniques novice historians, in this case undergraduates, use for interpreting class materials (primary and secondary sources, class and reading notes) and translating them into written argumentation. Special attention was paid to the organizational tools and types of interfaces the subjects use to conduct their work.

Contextual inquiry is a interview method that broadly follows the time-line interviewing technique, which is aimed at directly capturing the serial time dimension of subjects' sense-making behaviors (Wildemuth, 2009, p. 235). The four principles of contextual inquiry are context (understanding what people actually do rather than what they say they do), partnership (focusing on the user as the "expert" on their workflow), interpretation (translating interview results into design thinking), and focus (knowing your purpose in conducting the interviews) (Beyer and Holtzblatt, 1997). Given the time constraints on this project, the interviews followed guidelines outlined in the rapid contextual design paradigm, enumerated in Holtzblatt et al. (2004).

Interview subjects were selected from the Spring 2013 section of HIST 276, "The Modern Middle East," a course being taught by HL investigator Dr. Sarah Shields. The recruitment process began with the PI giving a short presentation to the entire class to familiarize them with the project and make them aware that some of them would be contacted to participate in interviews. The PI worked with a teaching assistant to identify potential candidates that satisfied these broad categories: an underclassman, an upperclassman, a history major, and a non-history major. This first effort at recruiting was only marginally successful, so an email was sent to the class asking for participants, which was more successful. Except for an upperclassman subject, the four participants who volunteered covered the desired types of participants. In order to maintain the participants' privacy, the instructor was not made privy to who was recruited and the users' data was anonymized. All participants were incentivized with a \$20 gift card after their interview was completed.

Each interview lasted for approximately one hour. In accordance with the contextual inquiry method, participants were encouraged to select a place of their choosing in which to conduct the interview, preferably in the location in which they would typically work on a history paper. Participants were instructed to bring any and all materials they use when writing a history paper - notes, laptop, books - with them to the interview. The investigator took some notes during the interviews, and audio was recorded for later processing.

B. Results

Table 1 shows basic pertinent information about each subject: age, class (freshman, sophomore, etc.), and major.

User	Age	Class	Major
User 1	19	sophomore	History
User 2	29	sophomore	Political Science (History minor)
User 3	18	freshman	Chemistry
User 4	19	sophomore	Political Science/Global Studies

Table 1. Pertinent demographic information about contextual inquiry interview subjects.

For the particular class the participants were taking, the requirement is that all readings for a given week be completed by the first class session that week. Only one user reported printing out the class readings. The rest cited the cost of printing as the reason why they do not do so, choosing to read the materials in a Web browser or PDF reader instead. Further, only one user reported marking up the readings with digital or analogue highlighter or notes on the actual source document.

However, all subjects reported keeping some form of notes when reading class materials. For this class, most of the materials set for reading are primary sources. User 1 is the only subject who keeps exclusively paper notes. Her notebook is arranged chronologically with no separation between reading and class notes. Sources are identified by title and class notes by the date the lecture took place. All users reported noting the basic facts of what the reading describes; one described this as writing down “objectively” what occurred. User 3 was the only one who mentioned that she will occasionally note an opinion on what the author is describing if what the reading depicts seems “odd or significant.” Two users reported that their notes take the specific form of a brief summary of the events or ideas described in the reading; User 2 said, “I know that I’ve gotten to the point where I’m comfortable using a source if I can give a brief summary or overview in my mind of what the author was trying to say.” He further described this summary as a paraphrase of “the author’s intent.”

All four users reported taking notes in class; User 1 made a point to say, “I pride myself on being good at taking notes.” Behaviors for recording in-class notes varied: two users took notes in a paper notebook, two on their laptops. User 4 said that her paper notes were a habit from high school, and that she worried she would get distracted on the Web if she took notes on her laptop. The structure of her notes was informed by how the instructor structures her lectures: User 4 quickly jots down the bullet points from the lecture slides, and then fills in details about the points below, connecting points with details by drawing arrows between them. User 2 also reported structuring his class notes based on the instructor’s PowerPoints, although keeping his notes in a Microsoft Word document affords him the ability to fill in details iteratively after typing in the instructor’s

bullet points first. Two users reported that they frequently write reminders in their class notes to look up unfamiliar information the instructor mentions later, or, if working on a laptop, perform a quick Wikipedia search while in class. Three out of four participants reported that their notes were structured using hierarchical bullet points; the other's paper and digital notes were kept in MLA outline form (I, A, 1, a, etc.). While User 2 felt an MLA-type outline would be too rigid and limiting, User 1 said that that form of outline helped her follow her train of thought better.

In the essay assignment on which the students were working around the time the interviews were conducted (see Appendix), the students were instructed, "Please underline your thesis statement." This suggests both the difficulty instructors have with students writing thesis statements, and the difficulty some students have with writing them. The students interviewed here did not report having significant difficulty with formulating thesis statements, but they took divergent paths to develop them. Figure 2 below shows an activity model comparing the workflows for each participant. One reported emailing with a teaching assistant to revise a thesis statement the TA thought overly broad and lacking a causal relationship between what was being described and why it occurred. In terms of conceptualizing the thesis statement and the argument more broadly, some users find the process to be more intuitive than others do. "I see what I want to say in my head," said User 1. "I see the note page and my mind zooms in on the part that I want." Developing a thesis statement gives User 3 more difficulty – she begins by roughing out an introductory paragraph to determine her thesis. The point in the process when users define a thesis statement also occurs at different times (see Fig. 2). Several users said they define a rough thesis statement at the beginning of the prewriting

process and use it to structure the rest of their activities. User 2 said he writes the thesis statement once he has already written the body of the paper: “I’ll know what I’m trying to say generally and write up my points, and then once I’m done I read through my different main points and then create a specific thesis statement about it.”

All users returned to their reading and class notes to flesh out their nascent arguments and find examples to use as evidence. While some said they keep sources open on their physical or digital desktops while prewriting and writing, others report preferring to take more detailed notes so as not to have to return to the sources themselves. Users were split on how they conceptualized the relationship between class notes and reading notes when using them to build an argument. User 1 uses her class notes to find examples to use in her argument, and then fleshes those examples out using details derived from primary sources in her reading notes; in her words, “The reading notes supplement the class notes.” Conversely, two of the other users see the class notes as supplementing the notes they took on the primary sources. One reported looking to her class notes for detail to support examples from her reading notes; the contrast between these two users nicely illustrates the variation in the detail and granularity with which different people treat these two types of notes.

Considered alongside mind maps and concept maps as paradigms for knowledge organization, outlines can be seen as a model of information visualization that is, to some degree, hierarchically arranged. As was suggested above, all four users were consistent in that outlines are the most important way they visualize information relationships in their notes and pre-writing documents for crafting an essay. This is also consistent with the methods used by the expert historians, as reported in the focus group findings above. No

users reported consistently using other visualization methods, such as mind maps or concept maps; not all of them were familiar with mind maps as a tool. User 1 reported that she has used mind maps in the past, but only if she was having difficulty conceptualizing an argument. User 3, a chemistry major, is familiar with concept maps from biology classes she has taken, although she has not used them in the context of a history class.

Although all users reported using outlines the most of any visualization tool, their practices in how their outlines are organized varied considerably. As was mentioned above, some use the more rigid MLA-style outlining system while others only use bullet points. Within the latter approach, users typically structured their class and reading notes with bullet points that have defined parent-child relationships. However, more idiosyncratic practices emerge in pre-writing documents. User 2 described his earliest essay outline as being something like a textual mind map - he collects a mixture of general ideas and quotations from sources with loose associative relationships between them rather than explicit logical or hierarchical relationships. Once this process is completed, he goes back and reorganizes his ideas and evidence from sources into a bulleted outline with more a more clear logical arrangement. While some users reported utilizing outline-style notes for class, reading, and essay pre-writing, User 3 does not arrange her essay notes into an outline at all. Rather, she begins by writing down a train of thought based on the themes she has identified from the assignment prompt, and then structures this into a paragraph with one sentence standing for each paragraph of the essay. This type of document might best be described as a “pre-writing abstract” of the

essay that is then used to direct her creation of a thesis and the process of gleaning primary source evidence from her reading notes.

The tools utilized for creating and organizing class, reading, and essay writing materials also vary, although not as much as was expected. Two users kept at least one type of notes in a paper notebook, while the other two were exclusively digital. Users were evenly split between Windows and Mac OS X, and Microsoft Word and a Web browser all four had in common with each other and with the experts from the focus group. Some use Microsoft Word's notebook layout template, which allows users to keep tabbed sections (as for class, reading, and writing notes) in the same .doc file. One used Microsoft OneNote to keep her reading notes, citing its tabbed interface as being useful. OneNote allows users to have tabbed sections – for each class, say – and tabbed sub-sections within those tabs as well, useful for differentiating between one week's reading notes and the next. Another kept his class notes all in one Word document, divided by the day the notes were recorded. One of the users who used a paper notebook also kept all her notes in chronological order, with reading notes leading into the class notes that discuss those readings. All noted that the more granularly (by week or even by class session) that readings and other class materials can be organized, especially those uploaded into the Sakai course management software by the instructor, the better.

Although in some cases this was the first history course the user was taking in college, all four users were reasonably confident in their ability to cogently write the type of short history paper they were assigned in this case. Various aspects of the writing process gave users varying amounts of difficulty. One found developing an outline for a paper most difficult, another coming up with a logical, well-scoped thesis statement.

None said that finding evidence in sources gave them much trouble, but this likely has more to do with the particular assignment that was discussed only required them to find evidence in a small number of primary sources discussed in class (see Appendix). The most frequently cited difficulty was with contextualizing the events and ideas they were discussing in class and assigned to write about. This is consistent with the findings in Van Boxtel & Van Drie (2004). However, in addition to some of the factors explored in that study, the most frequent difficulty here arose from the thematic, rather than strictly chronological, organization of lectures. “Class can be hard because she jumps around time-wise,” one user said: following one theme in history from 1800 to 1900 and then doubling back to examine another theme beginning in 1800 caused some difficulty. Another user said she was always relieved in the TA-led recitation sessions that the focus was more on establishing a clear timeline of events. She and a classmate resorted to making a rough timeline using the Prezi presentation Web application, which they organized by important concepts, such as “Napoleon’s invasion of Egypt” or “Ottoman Empire 1800-1890.” Themes help with synthesizing evidence, suggested one user, but context in time is key. Finally, at least one user cited some difficulty with the process of historical analysis itself. A political science major, she said, “In history, it’s difficult to make a point because everything isn’t right or wrong.” However, she did not report coming up with an argument as a cause of concern.

III. Discussion

Overall, one of the most surprising results of this study was that information visualization tools do not play a more significant role in the workflows of the expert or novice historians interviewed. Although mind maps and concept maps are two types of

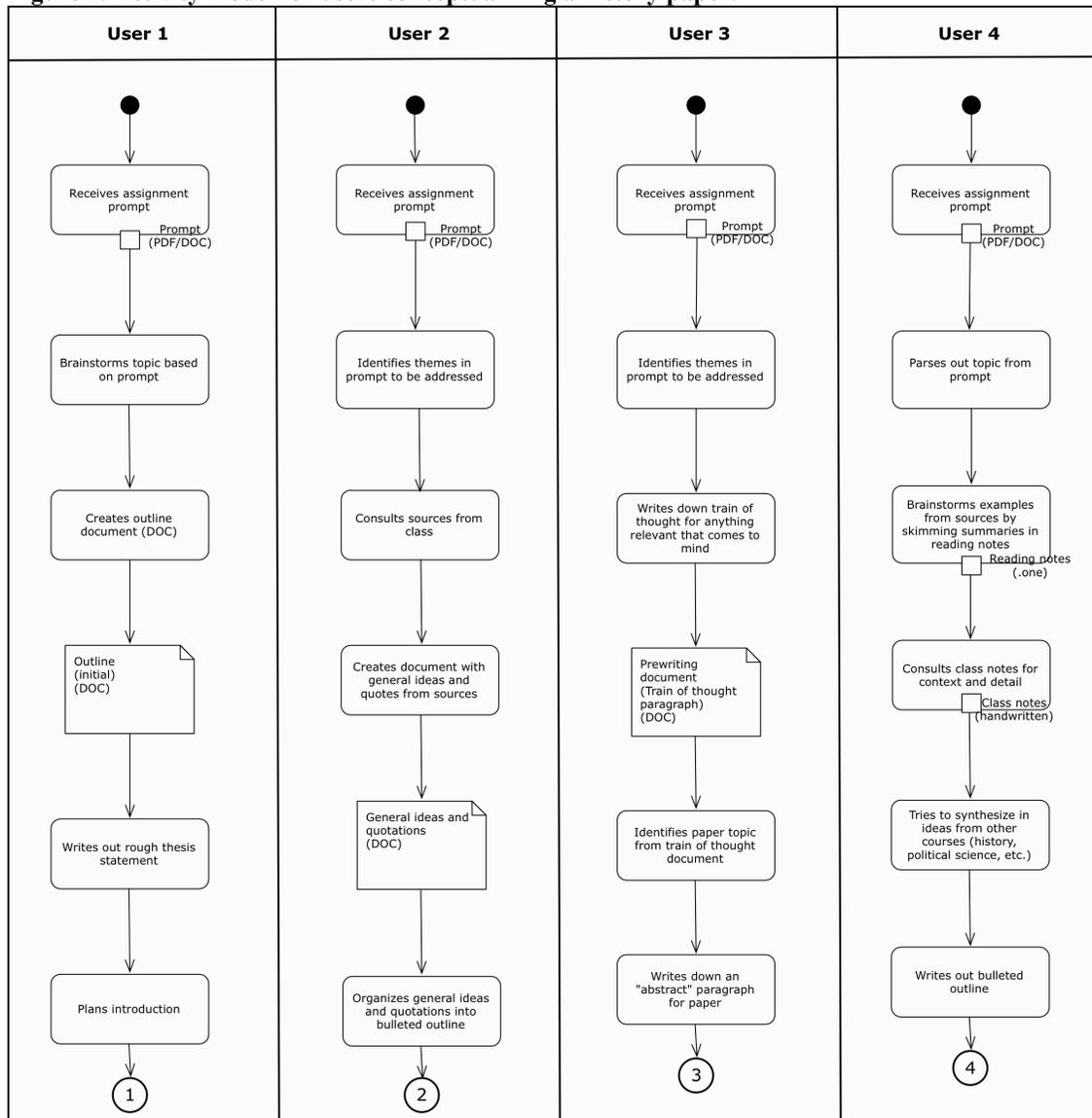
visualizations that HL will support, it is crucial that the application have a clear user interface and intuitive interaction design for the two types of visualizations most often cited: timelines and, most importantly, outlines. Further, the limited number of tools used, especially among the novice historian subjects, was unexpected. As discussed above, several of the undergraduates interviewed use only a word processor and a Web browser. Further, the undergraduates did not tend to mark up digital or paper readings, choosing instead to take notes. This behavior may not generalize across the entire undergraduate population, and certainly does not generalize to expert historians, so document mark-up affordances will be supported in HL despite the lack of evidence for their use by the small sample size of students interviewed. The number of tools used while writing a history paper seem to increase along with the scope of the project; the more experienced researchers discussed using citation management software and feature-rich word processing and note-taking applications like Mendeley and Evernote.

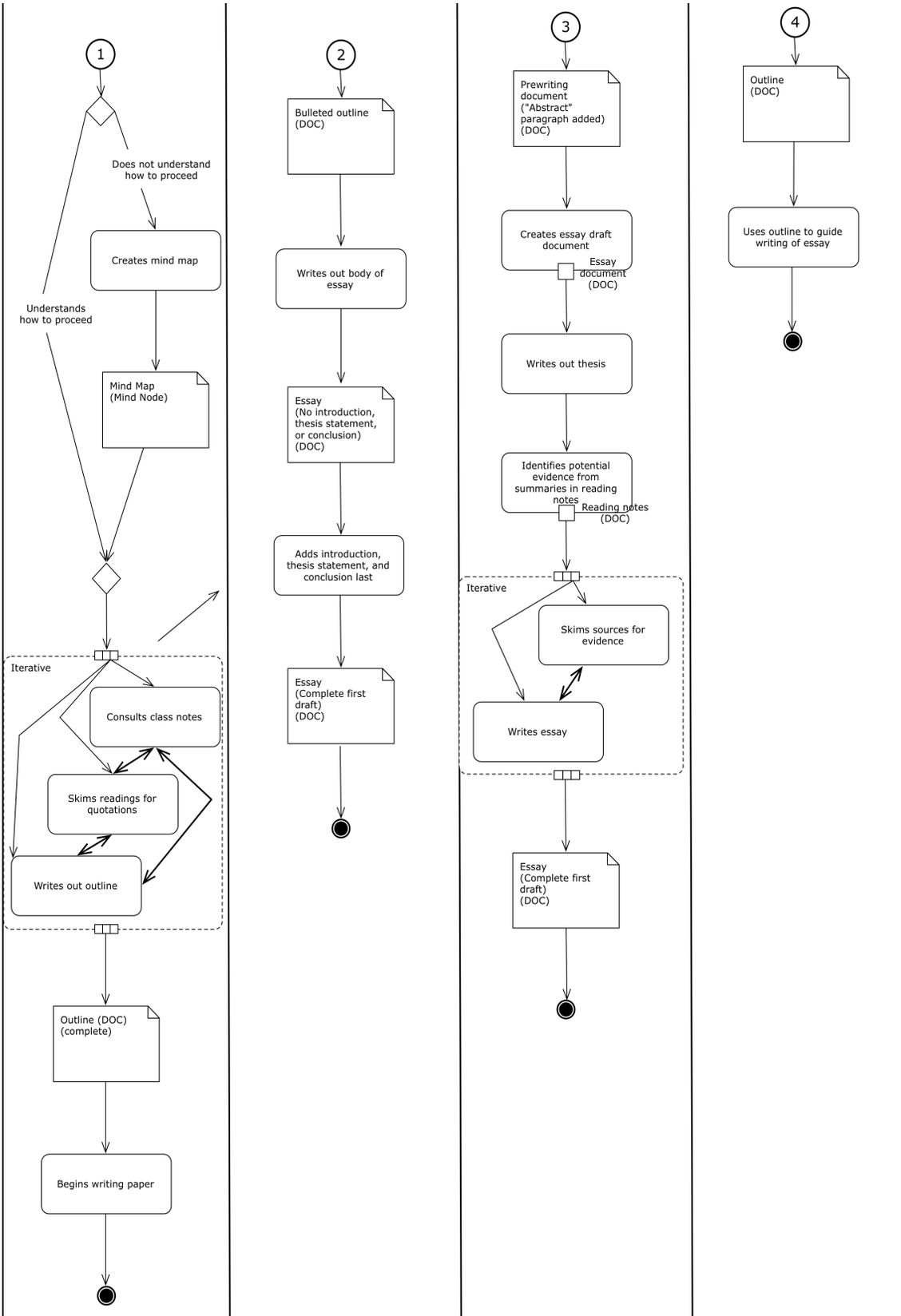
Finally, there is no generalizing that students will be “all-digital” or not depending on their level of experience. In many cases users keep some sort of paper notes by explicit choice, and HL must support these behaviors without obstructing them or adding unnecessary steps to users’ workflows. In fact, the user interviews crystalized that one of the most important things HL can do to help students learn how to do historical research is to get out of their way. It must provide affordances that enable users to take up notes, organize and mark up sources, and visualize connections between concepts and notes both in the note-taking stage of the process and in the paper pre-writing stage, but it must allow users to use these features in the manner that they choose. This non-prescriptive approach, along with the reduced cognitive load imposed on students by

integrating the disparate features used when performing the various tasks involved with conceptualizing and writing a history paper, will hopefully lead to increased historical understanding and better argumentation.

In terms of specific design choices clarified by the user research, it became apparent that HL would be most effective as a relatively simple application scoped for novice historians. In fact, more advanced users may turn to the application because of its straightforward, flexible, scalable interface. Full-text search and potentially even OCR are features many users find useful and expect in a research tool. The focus group further clarified the expectations for instructor-facing aspects of the interface. Instructors should be able to upload files into the application that can be distributed to the people in her classes. Also, if an instructor wanted to create a high-level concept map and instruct students to flesh it out as an assignment, this and other similar behaviors should be supported. The more experienced historians were also concerned that the interface not automate too much for students. For example, while being able to transform a mind map into an outline was cited as a useful feature, students should be able to rearrange the outline into a more logical form to support argumentation. As mentioned above, outlines are the most important visualization HL should support. Further, users should be able to keep outlines either in bullet form or in MLA outline style. Along with the expected metadata for a source – author, date, audience, associated concepts – users also liked the idea of being able to write a short summary for sources as a way of supporting their understanding. Finally, HL's organizational structure should be flexible – allowing users to keep one very long note for all class notes or a whole folder of class notes, for example – in order to support the idiosyncratic organizational practices of different users.

Figure 2. Activity model for users conceptualizing a history paper.





Design Strategy Brief

I. Goals

A. Design Goals

HL is a Web application that will help college students learn how to do historical research. The most immediate aim of this TEL project is to help students learn how to develop the document-level skills and higher-level strategies that comprise the disciplinary stance of the historian towards sourcing, corroboration of evidence, contextualization, and written argumentation.

The major features of HL include:

- a **hypermedia interface** that will allow users to access the application through a browser, regardless of operating system;
- **links**: every object in HL is automatically assigned a unique URI upon its creation, allowing the user to create semantic relationships between notes, sources, concepts (events, places, people, ideas), and visualizations of those concepts;
- **tags**: objects of the concept data type (see the data model in Figure 3) can be used as keyword tags to create relationships between those concepts and notes, sources, and visualizations which refer to them;
- a **text editor** interface (“Notes”) that will allow users to take and edit rich-text reading, class, and writing notes, as well as adding metadata about the notes to organize them into groupings (folders) and by keyword tags;

- a **reader** interface (“Sources”) that allows users to import and organize documents, mark them up with highlighting and notes, and input metadata about the source, including details of its provenance, personal organizational details, and keyword tags;
- an interface (“Visualization Tools”) that provides a workspace in which users can **visualize relationships** between concepts, notes, and sources in four different ways: outlines, mind maps, concept maps, and timelines. These visualizations can be saved for later use and exported to PDF or common image file types;
- **full text search** for all objects within HL, as well as **OCR** (optical character recognition) for imported objects, such as sources in PDF format or handwritten notes imported as an image file.

On a conceptual level, HL is a digital humanities tool that will actively foster historical interpretation and critical thinking through practicing document-level skills. Historical reasoning is a subset of reasoning more generally, making the skills and habits of mind used in historical reasoning transferable to other domains and contexts (Van Drie & Van Boxtel, 2008). It is envisioned as a tool that can be used as a part of undergraduate history instruction, or independently by students who want an integrated space in which to organize and conceptualize historical ideas into written arguments.

Although applications including Evernote, Mendeley, Scrivener, and others incorporate some of the features discussed above, no current application includes all of those features together in one interface with a focus on historical materials. The integration of these features presents an added value for users because it will lower the cognitive load imposed on them by having to switch back and forth between several

different applications while performing the task of organizing, interpreting, and writing about historical materials.

B. User and Audience Background

Undergraduate students enrolled in college-level history courses are the most significant user group for HL. Within this broad group, the first significant sub-group is students whose major is history. However, since many students enroll in history courses because they fulfill general education requirements or, indeed, because of a personal interest in the subject, non-history major undergraduates are another important user sub-group. Since these students may have less experience with historical reasoning, it may be of even greater import that HL support their needs and behaviors. By design, secondary-level history students and more experienced, graduate or professional level historians are excluded from the explicit user group for HL. That said, we believe the simplicity and flexibility of HL's user interface may make it a useful tool for these groups as well. But a thorough assessment of these groups' needs is beyond the remit of this project, and may have led to needlessly complex features and interface scaffolding.

Undergraduate HL users are likely to be "college age," that is, between 17 and 23 years of age. However, HL does not exclude users who are younger or older than this range; one of the users interviewed above was a 29 year-old with sophomore class standing. Although in recent years more women than men have been enrolled in college, HL users are as likely to be male as female. This user group will for the most part have no perceptual or physical handicaps that would impede their use of a Web interface.

HL users implicitly will have completed high school and have some college-level education, although it could be as little as a few weeks if they are using HL in their first

semester. There is no assurance that HL users will be native English speakers. Given these factors, and since there is at this time no plan to port HL into different languages, written parts of the UI, including controls and tutorials, should be pitched at a middle- to high-school reading level, using simple, straightforward English wherever possible. User knowledge of terminology specific to the historical domain will also be variable, although the use of clear but domain-specific terminology in the UI is important for the inculcation of disciplinary stance (Tabak & Reiser, 2008).

Another significant HL user group are instructors who use HL as a class tool. Again, HL is designed to be used in a college-level history course setting, so these users will be faculty members or graduate-level teaching assistants. These users will have completed or be engaged in completing an advanced degree, most likely in history but possibly in a related discipline. These users will most likely be between 22 and 65 years of age; the range of ages may be bimodal since TAs will tend to be in their 20s and history faculty tend to be older. Their comfort level with network technology and Web-based classroom tools will vary significantly, from users who have been active Web users for the last twenty years to those who prefer to minimize their contact with technology. It should be said the latter will be less likely to be interested in using HL unless required to do so.

C. Summary of Design Solution

Historical reasoning, like humanistic interpretation more generally, is a process of moving from associative thinking to hypothesis generation to argumentation (Bruner, 1986; van Boxtel & van Drie, 2004). Therefore, as a tool designed to foster historical reasoning, HL must operate as closely to the way historians (experienced and in-) do,

creating a space in which users can think intuitively, associatively, and rationally in turn. Further, the principle of “do no harm” comes into play in its design: HL should fit seamlessly into the workflows of students and instructors, and should not create any extra work for them. Since, as was discussed in the User Research section, the subjects’ most commonly-used tools are a word processor and a Web browser, this is further justification for making HL a Web application: within the browser, it fits nicely into subjects’ workflows. The application should also be flexible enough to support the idiosyncratic ways in which users approach notes, sources, and visualizations. HL has been designed to “get out of the way” by supporting users’ goals of interpreting historical data and working towards written argumentation, and not imposing a pedantic structure on their work.

Further, HL has been designed to reflect the sophistication of contemporary Web applications, which are increasingly as functional as desktop software. Web applications like Google Docs (<http://docs.google.com>), the Evernote Web client (<http://www.evernote.com>), and Cloud9 IDE (<http://www.c9.io>) are as richly interactive and functional as their desktop equivalents, and have all the advantages of being hypermedia systems that work in the Web. Because of the increasing sophistication of Web applications, it made sense to design HL for the Web rather than an application that would have to be downloaded and configured on a local system. All contemporary computers have a Web browser, meaning those with access to them can also have access to HL.

D. Outcomes

Oftentimes, there is a black box created when a history instructor hands out an essay prompt. The prompt is the input into the system, and the expected output is a cogent, insightful, well-reasoned piece of historical analysis. The processes by which that output will be generated are frequently not specified, or in some cases even thoroughly understood by student or instructor. A successful outcome for HL would be that it renders that black box transparent, that it becomes a tool that enables undergraduates to organize materials and conceptualize their arguments when presented with such a prompt. Further, a successful outcome from the instructor side would be that HL is a useful supplement to pedagogical materials and instruction. From the perspective of stakeholders in this project, a successful outcome would be an intuitive, flexible application that enables the successful outcomes specified for all user groups.

As was described in the User Research section, one of the most striking features in the data was the heterogeneity of the subjects' approaches when conceptualizing and beginning to write a history paper (see Fig. 2). HL should aim to inculcate an historian's approach to documents, concepts, and argumentation without railroading users' workflows. An unsuccessful outcome for HL would be a situation in which a user cannot perform the tasks associated with conceptualizing a history paper in the way that they are accustomed. This would lead to a state in which the historian's stance towards materials and argumentation would remain unlearned. Another unsuccessful outcome would be if, rather than decreasing the cognitive load of the task by presenting the features discussed above in one application, HL actually increases cognitive load by creating more work both for students and instructors. The goal is that HL should fit seamlessly into the takes

associated with taking a history class, processing the information learned during it, and transforming it into a written argument.

II. Design Rationale

A. General Strategy

Although there are many note taking, source annotating, and information visualizing tools available on the market, there is a paucity of applications that combines all these features and focuses specifically on historical information and reasoning. The design of HL is rooted in the practices, digital and analog, that students and expert historians perform when working on a project: taking notes, reading, thinking about, and organizing documents, and making connections between historical concepts and their own interpretations of them. Because there are many tools that perform the same tasks, HL must be as intuitive and flexible as those tools in order to meet users' expectations and "get out of the way" to allow them to work toward their goals. Further, HL must be as robust as the most sophisticated contemporary Web applications, fully-featured and stable. Hopefully, by combining the types of interfaces mentioned above with a focus on history and an interactive visualization interface, HL can exceed users' expectations for current historical research tools. As a digital humanities project, HL has been designed to promote historical interpretation by enabling users to make connections between historical concepts in a richly visual way without skimping on the textual features – a rich text editor and document editor – that users expect.

B. Specific Design Choices

For a graphical representation of the data types represented by these design choices, see the data model (Figure 3) at the end of this section.

- **Concepts/Nodes:** users can create historical concepts (unique and exclusive) and associate metadata and other concepts, notes, and sources with those concepts. Each concept is assigned a URI upon creation (see below for more details). Relationships between concepts can be mapped out using the visualization tools described below. Within the system, the UI for individual concepts is called a “node.”
- **Notes:** users can take and store class, reading, and writing notes in HL. Notes are created using a rich text editor that allows users to configure font, font size, font weight, lists (bulleted and numbered), and other standard rich text editor features. Some users keep all their course or reading notes for one class in the same note; others keep separate notes for every class, reading, or concept. In the interest of supporting idiosyncratic user behaviors, notes in HL can be as long or short as the user desires. Customizable metadata about each note can also be created and stored, including “related concept tags” that link notes to semantically related historical concepts (more about tags below). These notes are stored in customizable file folders and can be accessed from the HL file structure. Alternatively, they can be viewed and selected from a file browser at the bottom of the browser window. Notes can be exported in .txt or .html files.
- **Sources:** documents can be imported into HL from a local system or from the Web via inputting the resource’s URI. As with Adobe Reader or Preview in OS X (although not as fully featured), text documents can be manipulated while reading by using a highlighter and notes that can be inserted on the document itself. Users can also have a note open in a split screen with a source for simultaneous note

taking. Although many sources will be textual, multimedia resources – video, audio, and images – can also be imported and stored. Sources can also be shared via email or exported.

- **Visualization Tools:** HL includes tools that allow users to manipulate concepts, notes, and sources into four types of visual relationships. Because all tools can be used in the same “workspace,” users can move fluidly from one type of visualization to another. All visualizations can be shared by email, saved in a file folder to be retrieved later, or exported into PDF or image files.
 - **Outline:** among the participants in user research and usability testing, outlines were the most commonly used way for users to visualize relationships between historical concepts. HL allows users to drag and drop concepts around within the outline and to configure the outline to be bulleted or MLA-style (I, A, 1, a, etc.). Users can drag and drop links to notes or sources into the outline. Users can also type notes directly into the outline, such as quotations from those notes or sources.
 - **Mind Map:** a mind map is an associative diagram. Relationships in a mind map are not specifically named as in a concept map, nor are they necessarily hierarchical, as in an outline. HL users will be able to create mind maps between concepts, notes and sources (represented by “nodes”) using arrows that can be made different colors and shaped as the user desires. If the user wants a node to represent a general type of relationship (such as “people” associated with the concept “Yalta Conference”), the node can be configured to not have a URI so as not to clutter the system

with semantically impoverished everyday concepts like “people” or “stuff.”

- **Concept Map:** relationships between entities in concept maps, represented by arrows, are specified with names (i.e., the relationship between “Alexander Hamilton” and “*The Federalist Papers*” could be named “wrote” or “was written by”). Tzeng (2009) makes a distinction between comprehensive and thematic concept maps, the former being more detailed than the former. Both types of concept maps can be created in HL.
- **Timeline:** the most requested tool in the focus group, interviews, and usability tests was a timeline interface. Timelines are considered by experts and novices alike to be a vital tool for understanding historical context. Since users are accustomed to scrolling down in browser windows, time is oriented vertically in HL so as to be more intuitive. The timeline can be “zoomed in” to units as granular as months in a year and “zoomed out” to units as coarse-grained as “millennia” or “epoch.” Users can also drag the timeline to their desired time. The multiple ways of interacting with the timeline are specified in the interaction diagrams below. Filters can also be added to the timeline: visible events associated with particular countries, events, the users’ own projects, etc. Two periods of time can be seen side by side, which would be useful, for example, to compare side-by-side the development of democracy in the United States and in Japan, which occurred at much different times.

- **Split screen:** users can split the screen so that any two types of visualizations are on screen at once. Nodes can be dragged and dropped between the two visualizations; this action represents a “copy-paste” action in that dragging a node from a mind map into a concept map will not remove that node from the mind map.
- **Organizational features**
 - **Links:** Every object in HL is automatically assigned a unique URI upon its creation. This URI is mapped to the name of the object. Certain objects in HL are referred to as “concepts” since they represent historical concepts: events, people, and ideas. The other types of objects (notes, sources, and visualizations) are detailed below. If, for example, a user wants to link to the object “Federalism” from another object, she could type in the name “Federalism” as a keyword tag in the Related Concepts metadata field and the link between these objects would be created. In the Concept Map view, users can see all the objects in the system related to a given object, i.e., all the notes, sources, and other concepts related to “Federalism” or “Napoleon’s Invasion of Egypt.”
 - **Tags:** the names of concept entities can be used as keyword tags to create relationships between those concepts and the notes, sources, and visualizations to which they are semantically related. If a tag that does not exist in the system is entered as metadata (see below) on a note or source, a concept is automatically generated and stored in the Concepts file folder.

These tags support the “folksonomy” layer of information organization in HL and the search functionality.

- **Metadata:** all entities in the HL system have configurable and automatically generated metadata associated with them. In some cases, the values of the metadata field (such as the “title” of a document) can be input by users. In other cases (such as in metadata for entities of the data type notes), metadata fields can be customized by the user. In still other cases, metadata is generated automatically by the system, such as a timestamp when an entity is created or updated. Metadata is used to enhance the utility of nodes in the system; for example, adding the year “1788” to the concept “*The Federalist Papers*” will make that concept be linked “magnetically” to the year 1788 in the timeline visualization.
- **File folders:** the hierarchical file folder structure is another layer of organization in the system. By default, there are folders for each major data type in HL: notes, sources, concepts, and the four types of visualization tools. But new file folders can be created and are fully customizable for users, supporting the idiosyncratic ways in which they organize their materials.
- **Search:** HL supports full-text search for resources within the system. Search results are displayed as faceted by the type of data they are: sources, notes, etc. HL will also support OCR, conceivably allowing users to take pictures of, import, and search through handwritten notes or sources.

- **Features specifically not included**
 - **Advanced citation management:** the undergraduate history students interviewed for this project did not use applications like Zotero or Mendeley to manage their citations. As they are the main user group for HL, advanced citation management features were considered beyond the scope of this project. The expert historians who participated in the focus group did use those applications, however; this difference is largely down to the scope of projects students undertake in undergraduate courses. Some basic bibliographic metadata can be stored in HL about sources, and the data in HL can easily be exported into the citation management system of the user's choice.
 - **Argument maps:** argument maps are a type of diagram used in some circles, such as legal practice and philosophy, to graphically map out the structure of arguments. Although they do have features that would be helpful in providing users with a visual vocabulary to parse out the arguments made in historical sources (see Van Gelder, 2011), the user research revealed that users overwhelmingly use text notes and outlines to understand the arguments made in historical materials and, indeed, to map out their own arguments when writing essays. As such, another information visualization interface was considered to be superfluous.

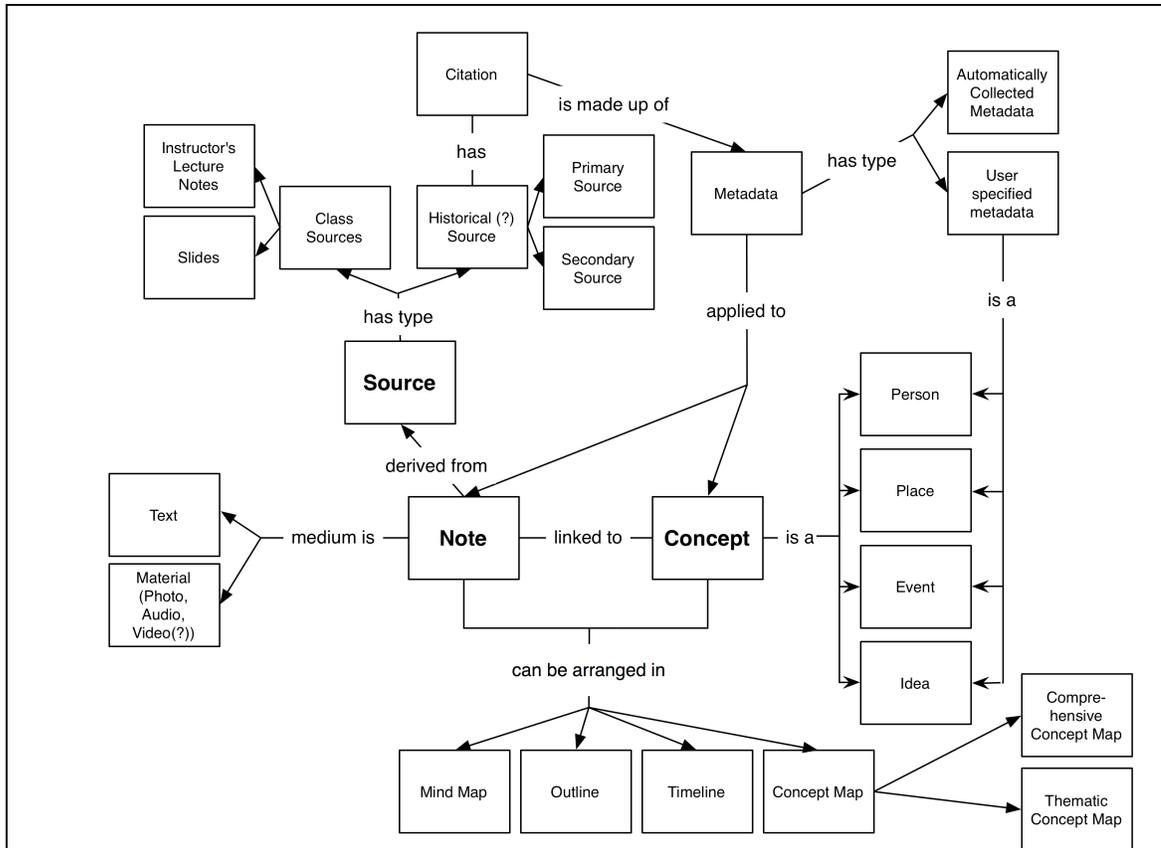


Figure 3. HL data model.

Personas and Scenarios

1. Lucy

a. Persona

Lucy is a 19 year-old sophomore Spanish major at UNC Chapel Hill. Her mom teaches in the Women’s Studies department at UNC, and since she was a kid Lucy has had the value of a “well-rounded liberal arts education” drilled into her. Lucy has always had a knack for languages, so she was receptive to this idea, but she hated her history classes in high school. Too many names and dates. But, when she signed up for a history course this



Lucy

semester about colonialism in Latin America purely for the honors credit, she was pleased that the emphasis was less on facts and more on themes and culture. It also jibed well with her growing interest in Latin American culture and dialects of Spanish. A political science course she took last semester about international relations also primed her interest; she now daydreams about name placards that say “Ambassador Lucy Forster.”

b. Scenario

Throughout her course on the history of colonialism in Latin America, the professor has been having the class using History Lab to manage their course materials. “Anything is better than Sakai,” he said on the first day of class, and he received a round of applause. The instructor encouraged them to use it to keep track of all their notes and sources, and to help them think through their writing assignments. For their first assignment, he had them make an outline using the application and submit it to him in

PDF form, and then met with each student individually to discuss the strengths and weaknesses of their proposed arguments. Lucy found this to be a useful exercise, both because it was simple to submit and straightforward to get feedback. It fit in with her workflow, anyway – she always works from an outline when writing a paper of any significant length.

However, another aspect of using History Lab for class was somewhat irritating. As a general rule, Lucy keeps all of her notes on paper, in a five-subject notebook with one section for each class. Since History Lab has note-taking features, the professor encouraged them to keep all their notes in it. This kind of threw Lucy – no matter how tired her hand gets, she feels like the act of writing out her notes helps her commit the information to memory better. But she's open to trying new things out, so she decides on a compromise of writing out reading and writing notes but taking class notes in History Lab. She quickly finds that it's easier to go back and add things in that the professor comes back around to when she's typing notes than handwriting them – a lot fewer arrows being drawn between points at different parts of the page. Also, after talking to a friend, Lucy found out that she can scan her paper notes in, add them as notes in History Lab, and something called OCR will recognize the words and make them searchable. It's not perfect, but it helps to be able to have the computer search those notes, too.

The “coming back around to things” is one of the main problems Lucy is having with processing the information in this class. They are following broad themes through a big period of time, from the earliest Spanish exploration in Latin and South America to the end of the course, when they'll talk briefly about the colonialist echoes of American intervention in Nicaragua and Panama in the early 1990s. The professor tends to follow

one theme through over a few centuries, like from Balboa to Bolívar, and then circle back to the Conquistadors.

For their second writing assignment, they've been given a couple extra primary sources to read and to relate them to one of the big themes of the class. Lucy knows she wants to talk about the theme of Bolívar and his effect on Latin American political philosophy, but is having trouble figuring out how to relate the primary sources to that theme. She decides to start at the very beginning. Using concepts she created while writing out class notes, Lucy makes a timeline that broadly shows the events and documents associated with Bolívar's life and accomplishments. She labels this theme "Bolívar." Lucy starts thinking about Bolívar's democratic ideals, and thinks about some of the democratic ideas that are expressed in the additional primary sources she read. She then creates a second stream lane in the timeline called "Democracy/liberalism in Latin America," and adds a few important events associated with this theme to that stream as well as the concepts for the primary source documents themselves. Put next to each other, she thinks she can start seeing on the timeline how, after Bolívar's death, some of his liberal democratic ideas continued to be espoused by politicians and thinkers in Latin America. Here, she thinks that she might have the beginnings of understanding how to relate these sources to the legacy of Bolívar. Lucy clicks Split Screen, and starts adding concepts and notes to an outline.

2. Julia

a. Persona

Julia is a 17 year-old freshman in her second semester at UNC. Perhaps unusually for a freshman, she knew within the first few months of college that she would declare

history as her major. She was split between Classics and History, but about midway through an early second semester discussion about Renaissance Florence she was sold. Julia was able to take two AP history classes – US History and European History – while in high school in Asheville, NC. Since she attended a Catholic high school, she was also able to take several Latin courses, including AP Latin, which spurred her interest in



Julia

classics. Julia decided to take a course about Renaissance Italy after reading Stephen Greenblatt's *The Swerve: How the World Became Modern*, a graduation gift from her aunt, over the summer. She was floored by the story of the rediscovery of Lucretius's *De Rerum Natura* in the early Renaissance, and has enjoyed working her way through the Lucretius ever since.

b. Scenario

Due to her self-possession and obvious passion for history, Julia's indulgent academic advisor gave her permission to sign up for the class about Renaissance Italy, a 300-level course, after a twenty-minute monologue about Poggio Bracciolini, 15th-century re-discoverer of Lucretius. A month into the semester, Julia is realizing that, although she can hold her own in discussions and grasps the readings just fine, she may have blustered her way into a semester-long research project for which she isn't prepared.

Julia's goal is to prepare a 20-25 page research paper discussing how a few members of the papal court – including Poggio – contributed to the revival of interest in classical texts in the early Renaissance. She has gathered a few disparate strands from class reading and from the sources she's found in the library – Petrarch, Poggio, cultural

life at the papal court at the beginning of the 1400s, the Council of Konstanz, monastic libraries in the Holy Roman Empire – but she can't quite picture how they fit together in her head yet.

The seminar class she is in isn't using any digital resources in class apart from the Sakai course management software as a repository for some of the readings and submission of written work. In confiding her uncertainty about the Renaissance class paper to another history major friend, the friend mentions that in his class they're using an application called History Lab to work with class materials and write essays. When she gets back to her dorm, Julia decides to give History Lab a try.

Julia logs in to History Lab using her UNC ID (Onyen). Once she is logged in, she sees that she can take notes, and decides later she might try importing or copy-pasting her notes from Word into History Lab. But after looking things over for a minute, she's immediately drawn to the sources button. Clicking on it, she follows the prompt to import from the menu bar above. Julia imports one of the sources she's found through the university library Website – once it's uploaded, she is pleased to see that there are features she could use to highlight the document right here in the interface. But she really likes the sidebar where she can add information about the source – she's an active user of photo sharing software where you can add information about your pictures to make them more meaningful. She isn't quite sure what the term "Connected Concepts" means, but after reading the help tip she realizes it's like adding tags to a picture on Flickr, except it also creates those concepts in the system. This source is about Poggio's humanist activities while at the papal court, so she tags it "Poggio," "papal court," "humanism,"

and “John XXIII”. After doing this, she clicks over to the Visualization Tools area and sees those four concepts in the little browser at the bottom of the screen.

She imports and adds information for several more of the sources she’s gathered. After she has about ten, she starts organizing them into folders in the left-hand sidebar so things don’t get disorganized, one for Poggio, one for Lorenzo Valla, and so on, being careful to add dates and connected concept tags to each. Julia figures she’s got about fifteen concept tags now, so she goes back to the Visualization Tools area. She doesn’t feel like she’s ready to outline yet, so she clicks Mindmap. Dragging and dropping concepts into relationships with each other, after awhile a few themes start to emerge. It’s interesting, she thinks, how the exact features of the classical documents they were finding didn’t really make substantial changes to how they viewed humanism; they just seemed to want to keep acquiring documents, keeping thorough analysis til later. A light goes on. Julia’s ready to really start working on this paper.

3. Olwen

a. Persona

Olwen is a 39 year-old associate professor in UNC’s History Department. After finishing her Ph.D. in economic history at the London School of Economics, Olwen took a post-doctoral position at Yale working on a project associated with the Text Encoding Initiative to coordinate the processing of the university’s collections about international labor movements in the early 20th century. An expert on early 20th-century European economic history – especially Keynes, the development of European



Olwen

social democracy, and the Great Depression – Olwen thought this post-doc would be a great opportunity to learn more about labor in the US. It turned out she was as taken with the process of encoding documents as with the documents themselves, making her an eager advocate for the digital humanities. She has taught courses on 20th-century European history at UNC for the last two years, and is collaborating with colleagues at Birkbeck on a digital repository of materials by and about the Marxist historian Eric Hobsbawm (an early inspiration of hers) and Marxist and socialist historiography more generally.

b. Scenario

This semester Olwen is teaching her dream course, an undergraduate honors seminar called “Why Marx was Right: Capitalism and Global Crisis,” and a 100-level lecture course about European history from 1850 to 1950. She teaches the latter every semester, and she is taking a different tack this time around. After a few years of creeping unease, Olwen’s frustration with teaching how to craft an historical argument came to a head last semester when she returned the class’s first graded essays and got to explain to the class what the word “bimodal” means. It’s a perennial problem: especially in lower-level courses, some students seem to understand how to build an argument from evidence taken from sources read for class, an equal proportion do not.

Olwen’s frustration led her to look into different strategies and tools for structuring the course this semester. One of the problems she has noticed when talking to students during office hours is that, while they are able to keep materials organized well enough, it’s synthesis that’s missing, bringing everything together into an argument. She takes some time to think about her own practices: a few years ago, when she was working

on her first book, she started using Scrivener to manage all the parts of a large, multi-part manuscript and Zotero to keep track of her source materials. While Zotero or another such citation management system could be useful for her seminar students, Olwen doesn't feel like Scrivener has the right set of features to help students synthesize an argument for a relatively short paper. Further, such general-purpose software might not really help with history-specific issues.

After doing some research, she finds History Lab, and is pleased with its general organization and source management features, but is especially taken with the visualization tools. After creating a number of concepts pertinent to subjects covered in her European history 1850-1950 course, she clicks into the Concept Map visualization. To her, this seems like the most useful visual tool in the interface because it allows her to specify the relationships between concepts. It quickly becomes easy to see, for example, the ways German unification in the 1870s and economic and political shifts in the following decades set the stage for the First World War. Olwen clicks Split Screen and sets the second pane to Outline, where she starts rearranging the concepts and relationships she's mapped out into an outline outlining how economic and political change in Germany led to war. She then saves both the concept map and outline to folders in History Lab, and then exports each as PNG image files to her Dropbox folder for the class next semester, thinking they might be useful to use in a History Lab tutorial.

How, though, Olwen wonders, could History Lab be used not only for organizing and thinking about materials for written work, but for other assignments? After contemplating her concept map for awhile, she thinks, why not take out a lot of the detail she's added to the concept map, leaving just the high-level thematic concepts, and have

students fill in the details and submit that as a sort of pre-writing assignment?* Olwen comes away thinking History Lab might be a useful classroom tool, and perhaps a good addition to the applications she herself uses when working on a research project.

* This scenario is inspired in part by the distinction between thematic and comprehensive concept maps in Tzeng (2010).

Usability Evaluation

I. Study Design

Usability testing of HL was conducted after the user research and third iteration of design had been completed. It was decided that at that stage in the design process it would be most useful to use a formative usability testing technique to refine the design of the application using input from users. Accordingly, a paper prototype was developed following the guidelines established in Snyder (2003).

The tasks for the usability tests were designed to be scenario-based with tasks varying in level of granularity but all based in “real-life” interactions users would be able to perform using HL. Given the narrowness of the user group tested, the scenario was relatively straightforward: users were asked to imagine that they were using HL in an undergraduate history course like the one in which they were enrolled. As will be shown in the wireframes below, for thematic unity and the designer’s convenience many of the concepts sketched had to do with federalism in the United States; as such, participants were asked to imagine that they were in an American history course. Users’ familiarity with American history was variable, but did not impede the completion of the tasks. Task design is one of the most difficult aspects of usability test design, but the difficulty is worthwhile since, as Snyder writes, “a good task is like a spotlight that illuminates your interface, showing you the parts that work well and the issues that get in the users’ way” (2003, p. 121). Snyder’s precepts for task design, which follow generally accepted

usability test design best practices, include grounding the tasks in goals that matter to users but that also address questions pertinent to the success of the project from the designer and stakeholder’s perspective.

As with the contextual inquiry interviews, subjects were selected from the Spring 2013 section of HIST 276. A recruitment email was sent by the instructor to students inviting them to contact the facilitator to set up an appointment. Following Nielsen’s well-known heuristic that testing five users maximizes the cost-benefit ratio for qualitative, design-driven usability evaluations, five participants were sought (Nielsen & Landauer, 1993; Nielsen, 2012). Subjects were offered \$20 for participating. Due to a low response rate and time constraints, three subjects were tested. One user was a pilot subject who was not enrolled in the course; a friend of the facilitator, it should be said that this subject was a convenience sample. However, she has an extensive background in the humanities, and substantive data was generated from the pilot test in addition to “working out the kinks” in its task design. Table 2 describes pertinent information about the subjects who participated in usability testing.

User	Age	Class	Major
User P	26	post-graduate	Ecology/English
User A	20	junior	History/Journalism
User B	20	junior	Global Studies

Table 2. Pertinent demographic information about usability test participants.

Tests were conducted in the Interaction Design Lab at the School of Information and Library Science, University of North Carolina at Chapel Hill. In addition to the facilitator, whose role was to conduct the test and assist the user in manipulating the elements of the paper prototype, an undergraduate information science student was retained to take notes. Notes were taken using the Timestamped Field Notes iOS

application (<http://neukadye.com/field-notes.html>) on an iPad with a Bluetooth keyboard attached. The proceedings were also videotaped for later reference.

II. User Tasks

The format followed here for specifying users tasks is derived from Snyder (2003, p. 129-136). Users were shown the instructions specified in the “Instructions for user” section on individual cards for each of the eight tasks. The introductory script read by the facilitator is included in the appendices.

Task 1, navigation/labels

Goal/Output:	<ol style="list-style-type: none"> 1. User is clear on what the navigation labels mean. 2. Navigation labels have been optimized with user input.
Inputs/Assumptions:	
Steps:	<ol style="list-style-type: none"> 1. Explain areas of the application 2. Have user write out labels with their chosen names 3. Have user order areas as they desire
Time for expert: (numbers refer to Goal/Output numbers)	N/A (test-only task)
Instructions for user:	<ol style="list-style-type: none"> 1. Now, I will explain to you the areas of this application. 2. Using Post-It tabs, write out the labels you would use to describe those areas. Think about if there are any category names you could use to organize some of the areas together. (If you can't think of any, or don't want to use any, that's fine too!) 3. Place your labels below the file menu in the order you think would be best. 4. I'll now show you the labels that I've come up with. Do you think you'd be confused using them?
Notes:	<ul style="list-style-type: none"> • Say all the areas: notes, sources, concept map, mind map, outline, timeline • Use printed labels after this task is completed, but note any interesting alternatives the user comes up with

Task 2, sources

Goal/Output:	<ol style="list-style-type: none"> 1. User is able to import a source. 2. User is able to mark up a source. 3. User is able to add metadata to a source.
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Inputs/Assumptions:	
Steps:	<ol style="list-style-type: none"> 1. Navigate to Source area OR select Import 2. Select Import Source 3. Import File 4. Use markup controls to highlight, add notes, etc. to source 5. Add metadata in order specified in sidebar
Time for expert: (numbers refer to Goal/Output numbers)	<ol style="list-style-type: none"> 1. 1 min. 2. Variable depending on length of document (negligibly different from time for novice) 3. 3-5 min.
Instructions for user:	<ol style="list-style-type: none"> 1. You decide you want to import a document from class into HL. How would you go about doing that? 2. Now, select the file named “Concerning Forces...”. Import it. 3. Add information to the fields specified in the sidebar to the right. Think aloud about other kinds of information you might want to record about a source. 4. Spend a little time skimming the source. Highlight a couple important-seeming passages. Make a note about a few things on the document itself. Think aloud about other ways you might want to mark up the document while you’re reading it.
Notes:	<ul style="list-style-type: none"> • Enquire as to what kind of markup controls the user would like • Make sure to emphasize connected concepts in subtask 3

Task 3, notes

Goal/Output:	<ol style="list-style-type: none"> 1. User is able to create a new note. 2. User is able to add text to a note. 3. User is able to style the text. 4. User is able to open an existing note. 5. User is able to “flip” to the note metadata screen and create metadata for the note. 6. User is able to export the note.
Inputs/Assumptions:	
Steps:	<ol style="list-style-type: none"> 1. User navigates to Notes area 2. User navigates to file menu OR to browser 3. User opens an existing note 4. User creates a new note 5. User edits text in note 6. User styles note text 7. User clicks info button to flip to metadata screen.

	8. User adds metadata to note.
Time for expert: (numbers refer to Goal/Output numbers)	<ol style="list-style-type: none"> 1. Less than 1 min. 2. Variable (negligibly different from time for novice) 3. Variable (negligibly different from time for novice) 4. Less than 1 min. 5. 3 min. 6. Less than 1 min.
Instructions for user:	<ol style="list-style-type: none"> 1. Navigate to the Notes area. 2. Open an existing note. 3. You want to add text to this note. How would you go about doing that? 4. Now let's create a new note. 5. Add a title to the note. 6. Type some text in the body of the note. 7. Style the text so that some important words are bolded or italicized. 8. Add a bulleted list to the note. 9. Add a hyperlink to the note. 10. Add some metadata to the note. Make one of the connected tags "Federalism".
Notes:	<ul style="list-style-type: none"> • What kinds of metadata would the user find helpful to have for notes?

Task 4, stuff view

Goal/Output:	1. User is able to manipulate entities by dragging them from the file structure or from the browser drawer.
Inputs/Assumptions:	
Steps:	<ol style="list-style-type: none"> 1. User navigates to Visualizations area 2. User toggles to "stuff" view (if it is not the default view) 3. User drags and drops entities from the file structure OR from the browser drawer
Time for expert: (numbers refer to Goal/Output numbers)	1. 1-3 min.
Instructions for user:	<ol style="list-style-type: none"> 1. Navigate to the Visualizations area. 2. Move some concepts into the visualization screen.
Notes:	<ul style="list-style-type: none"> • What name would users have for this view? • Visualizations area should default to "stuff" view • Arrange concepts in the browser

Task 5, mind map

Goal/Output:	<ol style="list-style-type: none"> 1. User is able to toggle to the mind map view. 2. User is able to make relationships between entities. 3. User is able to add default nodes to specify certain types of relationships.
Inputs/Assumptions:	<ul style="list-style-type: none"> • User has navigated to Visualizations area
Steps:	<ol style="list-style-type: none"> 1. User toggles to “mind map” view 2. User adds relationships to entities in place from stuff view 3. User adds default relationship nodes to describe certain relationships between entities
Time for expert: (numbers refer to Goal/Output numbers)	<ol style="list-style-type: none"> 1. Less than 1 min. 2. Variable, probably 3-30 min. 3. 2 min.
Instructions for user:	<ol style="list-style-type: none"> 1. You decide you want to arrange the concepts you’ve moved onto the screen in a mind map. Toggle to the mind map view. 2. Create some relationships between the concepts. 3. Add some default relationship nodes to the mind map to specify certain kinds of relationships. Think aloud about what other default nodes you would like to see.
Notes:	

Task 6, outline

Goal/Output:	<ol style="list-style-type: none"> 1. User is able to toggle to outline view, reorder concepts by dragging and dropping, add notes, toggle outline type, and add/remove entities from the outline. 2. User is able to enter the split screen mode between mind map and outline.
Inputs/Assumptions:	<ul style="list-style-type: none"> • User has navigated to Visualizations area
Steps:	<ol style="list-style-type: none"> 1. User toggles to “outline” view 2. User rearranges nodes within outline 3. User toggles between numbered and bulleted outline formats, chooses preference 4. User adds new nodes/notes to outline 5. User removes a node from the outline 6. User selects Split Screen view 7. User selects mind map on left, outline on right 8. User drags and drops nodes between outline and mind map 9. User clicks one node to enter concept map view.
Time for expert:	<ol style="list-style-type: none"> 1. 5-30 min.

(numbers refer to Goal/Output numbers)	2. Less than 1 min.
Instructions for user:	<ol style="list-style-type: none"> 1. You decide you would now like to create an outline using the concepts you've mapped out in the mind map. Toggle to the outline view. 2. Does the order the nodes are put in seem like a logical outline order? If not, rearrange them into a more sensible order. 3. You decide you'd rather make a bulleted outline. Find a way to change the outline format. 4. Add some new concepts to the outline. 5. Add some relevant notes to the outline. 6. You decide the scope of the outline is too large. Remove one of your bullet points from the outline. 7. You want to refer back to the mind map you made while you are making the outline. Find a way that you can have both the mind map and the outline on screen at once. 8. Move some nodes between the mind map and the outline. 9. You decide you want to look at one particular concept in more detail. Click on the "Federalism" node to do so.
Notes:	<ul style="list-style-type: none"> • "System" must reconfigure nodes into rough outline between mind map and outline tasks • Default to MLA-style outline • Includes split screen subtask • Decide which node user to click through to get to concept map task

Task 7, concept map

Goal/Output:	<ol style="list-style-type: none"> 1. User is able to navigate to an existing concept. 2. User is able to create an historical concept. 3. User is able to link the concept she's created to other entities (concepts, notes, sources). 4. User is able to save concept map for later use.
Inputs/Assumptions:	<ul style="list-style-type: none"> • User has navigated to Visualizations area • User has performed task 6, navigating to the concept map view through the hyperlink of an entity in the outline view • Otherwise, user would first navigate to Visualizations area and toggle to the "concept map" view
Steps:	<ol style="list-style-type: none"> 1. User clicks through from concept map view via a hyperlinked entity 2. User explores the connections that entity has 3. User specifies the relationships between the entity and connected entities

	<ol style="list-style-type: none"> 4. User creates a new concept 5. User creates and names links to the other concepts 6. User uses symbols to create context around concept maps 7. User saves concept map
<p>Time for expert: (numbers refer to Goal/Output numbers)</p>	<ol style="list-style-type: none"> 1. Less than 1 min. 2. Less than 1 min. 3. Variable, probably 5-10 min. per concept depending on the complexity of the concept map 4. Less than 1 min.
<p>Instructions for user:</p>	<ol style="list-style-type: none"> 1. You are now looking at the concept “Federalism”. Find a way to view all the things associated with this concept. 2. <Something about the associated things> 3. You decide you want to create a new entity to associate with “Federalism.” Create a new concept and name it “Federalism in China”. 4. You want to find out the name of an important figure in the history of federalism in China. Search for “federalism in China” and see what comes up. Make a note of what year the figure made proposals about federalism in China. 5. Create another new entity with the name of the figure you found. 6. Create relationships between the person, Federalism in China, and Federalism. 7. Name those relationships. 8. Add some context to the concept map by adding a symbol in which you can put the year when the figure made proposals about federalism in China. 9. Save this concept map for later use.
<p>Notes:</p>	<ul style="list-style-type: none"> • One of the concept created here will be used in the timeline task • This task includes the search subtask (subtasks 4 and 8) • The figure I’m going for in the search subtasks is Sun Yat-Sen. But it doesn’t necessarily have to be him. • User can also navigate to the concept map by toggling to the concept map view

Task 8, timeline

Goal/Output:	<ol style="list-style-type: none"> 1. User input on horizontal/vertical timeline view is gathered. 2. User is able to manipulate entities on timeline. 3. User is able to organize the timeline by a few different concepts. 4. User is able to “zoom” the timeline to different levels of granularity.
Inputs/Assumptions:	<ul style="list-style-type: none"> • User has navigated to Visualizations area
Steps:	<ol style="list-style-type: none"> 1. User toggles to the timeline view 2. User “zooms in” to more granular timeline view (3 possible ways to do it) 3. User “zooms out” to less granular view (3 possible ways to do it) 4. User selects desired timeline view level (3 possible ways to do it) 5. User selects entity created in outline task 6. User drags and drops entity onto timeline 7. User adds other entities to timeline 8. User reorganizes timeline by country filter
Time for expert: (numbers refer to Goal/Output numbers)	<ol style="list-style-type: none"> 1. N/A (test-only task) 2. 1-5 min. 3. 2-10 min. 4. 1-5 min.
Instructions for user:	<ol style="list-style-type: none"> 1. You want to make a timeline about Federalism in the United States. Toggle to the timeline view. 2. See if you can change the period of time that is displayed on the timeline, i.e. centuries rather than decades or individual years instead of centuries. 3. Select the entity “<i>The Federalist Papers</i>” and add it to the timeline at the appropriate year/decade. 4. Add a few more entities to the timeline. 5. You decide you want to expand the scope of the timeline to compare the development of federalism in the US and in China. See if you can arrange the timeline by country and add or create some entities to populate the timeline.
Notes:	<ul style="list-style-type: none"> • Gather user input on horizontal or vertical timeline view • Incumbent on subtask 3 is searching for the year <i>The Federalist Papers</i> was published (1788). • Subtask 5 will require the user to: filter by country, zoom the timeline to span the 1700s to the 1900s, add and create entities.

III. Discussion

Data from the usability tests were processed using the notes and video from each session. Significant findings were extracted and ranked as high, medium, or low priority to direct redesign actions. Sketches made by the users and the facilitator during the tests were also used in design iteration. As was suggested by Snyder (2003), the paper prototype elicited the most feedback about usability issues pertaining to concepts and terminology, navigation and workflow, and interface layout and content. Although several other changes to the final design were suggested by usability test data, only a few significant examples will here be discussed. The rest of the changes have been incorporated into the designs represented in the wireframes below.

General feedback included users' desire for more help icons to describe certain features of the interface. One user was unfamiliar with the concept of mind maps altogether, but thought that an explanatory help tip would allow her to quickly understand this affordance. As mocked up for the tests, the HL paper prototype only allowed for importing sources from files on a local system. Two users expressed the need to import sources or other documents by supplying their URIs. This behavior is supported in the wireframes below. Labels that consistently gave users trouble included the "quick add" label at various places in the interface: the vagueness of "add" leads the user into a state where she does not understand if her action will invoke an existing entity or create a new one. The "Visualizations" label for one of the three primary areas of the application was also consistently reported to be confusing. Suggested alternatives included "visualization tools" and "visual tools."

Three concepts in the interface gave users persistent difficulties: the so-called “Stuff View” in the Visualizations area, the default relationship nodes in the mind map visualization, and the functionalities of the concept map visualization. The “Stuff View” (a poorly conceived label for which users nor facilitator could come up with a better name) was envisioned as a structureless visualization in which users could drag and drop concepts into the visualizations work area before selecting a type of visualization, such as a mind map or a timeline, in which to arrange them. One of the purposes of Task 4 in the usability tests was to investigate whether participants found this to be a useful part of the visualization creation workflow. Only one user thought this would be a useful affordance. As such, in the wireframes below the “Stuff View” has been removed in favor of a prompt saying “Choose a tool to get started” as the default setting when the user enters the Visualizations area, which disappears when the user has selected a visualization type.

In the “Mind Map” view, default relationship nodes were envisioned as a way that types of relationships could be specified that do not require hyperlinks in the system. That is, types of relationships like “people” or “events” are associated with many historical concepts, and could be used to organize several instances of the same relationship type in one area of the mind map. However, both the label and the concept were shown to have significant usability issues. Part of the issue was that drop-down menus seem to be a weakness of the paper prototype; here and in other areas, users consistently had trouble realizing that clicking on a collapsed menu would expand it. On a conceptual level, users expressed skepticism that specifying types only three types of relationships – the three used in testing were “people,” “events,” and “documents” – would be flexible enough to cover the types of relationships that they would want to

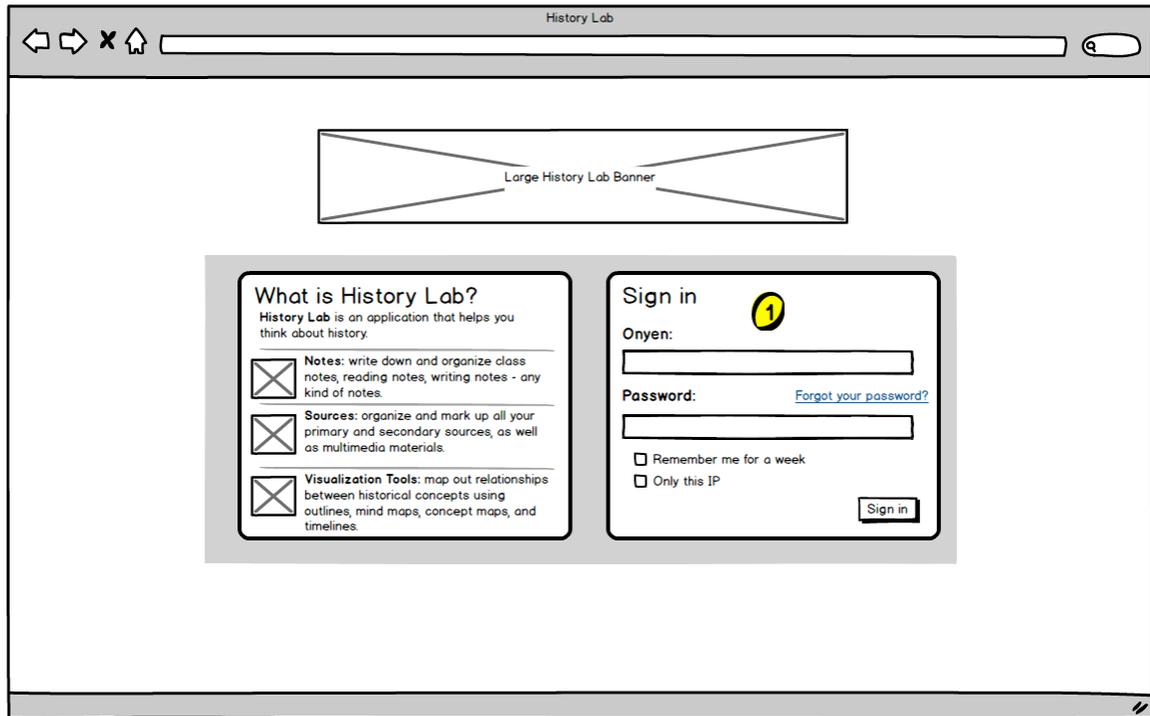
specify, or indeed that imposing such hierarchical relationships would be of a piece with the intuitive, associative relationships in mind maps. As such, in the wireframes below “default relationship nodes” have been deprecated in favor of users being able to toggle on or off whether a concept node has a URI, with the hope of preventing cluttering the system with everyday concepts that are too vague to be helpful, like “people” or “events.”

In terms of design, the concept map view was the most difficult to envision. The difficulty arose from the desire to avoid having two areas for concepts: one a customary concept map of historical concepts (in HL, relationships between linked concept nodes), and the other a view where users could see all the entities in the system – notes, sources, and other concepts – associated with a given concept. There is a conceptual issue here between the “historical view” and the “system view” of entities related to a given concept. Fortunately, the process of usability testing clarified these issues. In the final iteration of the wireframes, a Concept Detail View was introduced to show a description of the concept and all the resources in the system associated with it arranged by type. This way, the concept maps only show historical and conceptual relationships, and the “system view” of the concept and all its associated resources are represented separately to avoid confusing users’ mental models. Another user suggested that, in the HL search bar, if a concept were searched for that notes, sources, and visualizations related to that concept could be displayed faceted by their type, akin to the Searchlight feature in Mac OS X. This, too, has been implemented in the wireframes.

Wireframes

In the following section, wireframe sketches of the History Lab prototype are presented along with explanatory notes for each sketch. Notes are marked by yellow numbers on the sketch. Fine detail may be somewhat difficult to see on the wireframes due to formatting constraints. High-resolution versions of the sketches will be available at www.mattpoland.net.

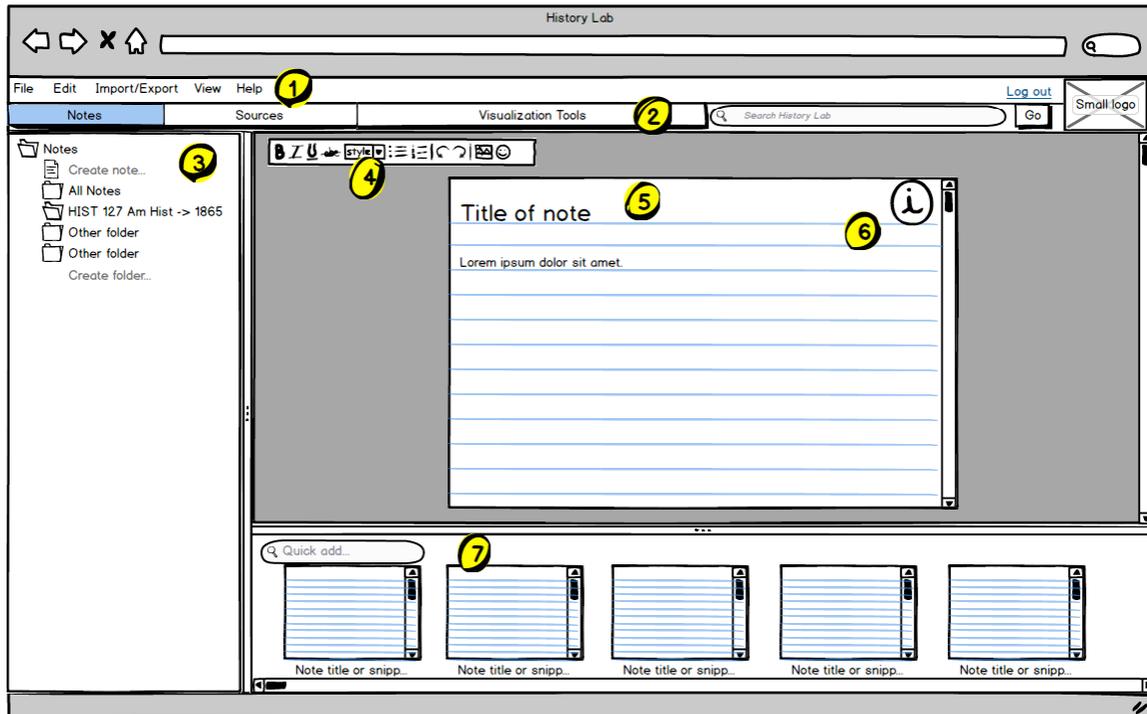
1. Login screen



Notes:

1. Initial deployment of HL will be on the campus of UNC Chapel Hill, so the sign in presented here uses the UNC Onyen system. Should the system be deployed for other campuses, using their systems or an open registration could be considered.

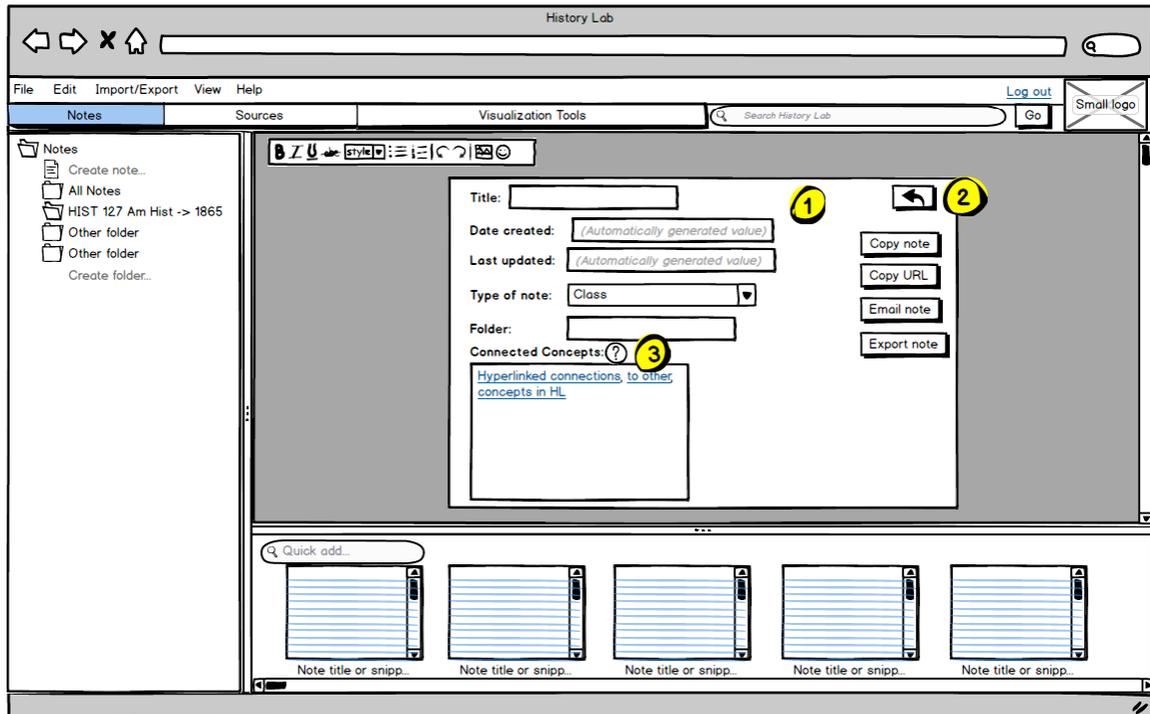
2. Notes state 1: note content screen



Notes:

1. The application menu bar is persistent throughout. Each menu item with its sub menus is wireframed separately.
2. These buttons represent the global navigation for the three different areas of the application: Notes, Sources, and Visualization Tools.
3. File folder menu displaying all the notes in this user's system. This sidebar can be contracted or expanded. Notes can be created by a number of different means (see interaction diagram below), and folders and subfolders for notes can be created by clicking "Create Folder." Notes can be opened by clicking or dragging and dropping from the file menu.
4. Rich-text editor for allowing users to style their notes.
5. Each note has a title and content. Notes can be as long as users desire to support heterogeneous note taking behaviors.
6. Clicking on the information "i" button will "flip" the note over to reveal the second note state where metadata for the note can be recorded.
7. File browser as an alternative way to navigate through the notes to the hierarchical file structure. Users may scroll horizontally to find a desired note or type the name in the "quick add" search box to display it.

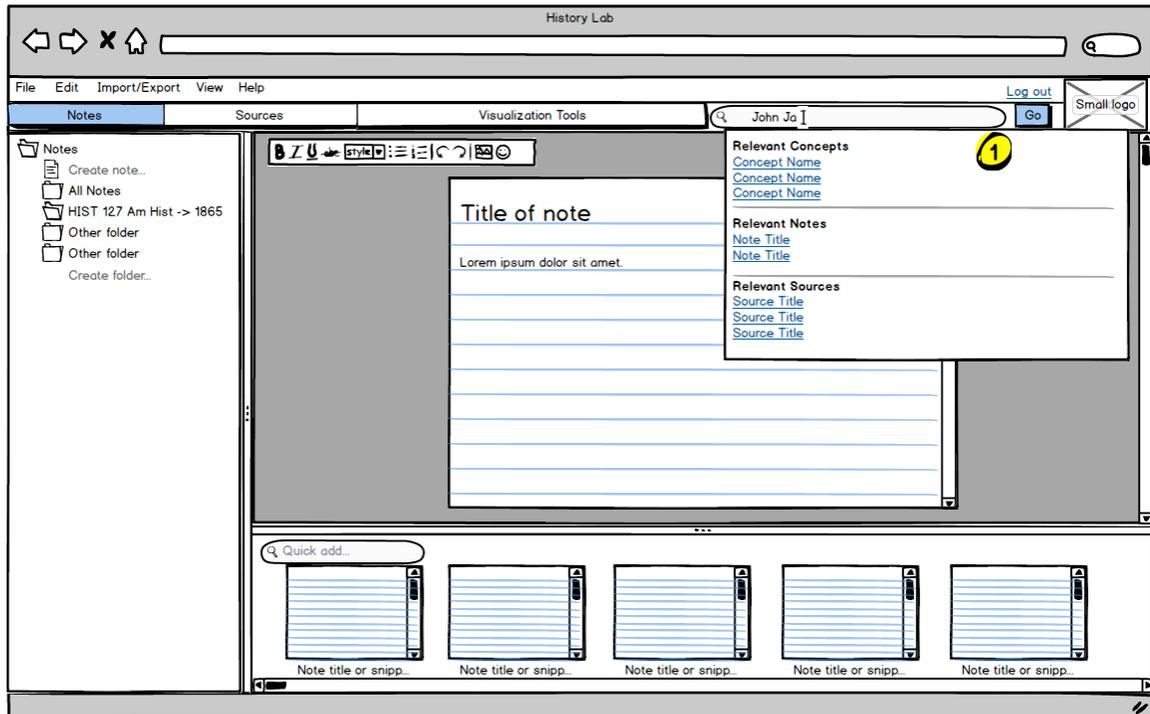
3. Notes state 2: note metadata screen



Notes:

1. Note metadata screen where user-generated and automatically created metadata are shown. A number of clear actions are afforded by the buttons to the right.
2. Clicking the back arrow button will “flip” the note back over to the main content “side” or screen.
3. The question mark icon pops up an explanatory window to explain how to interact with Connected Concepts (see Design Brief above and interaction diagram for creating a concept below).

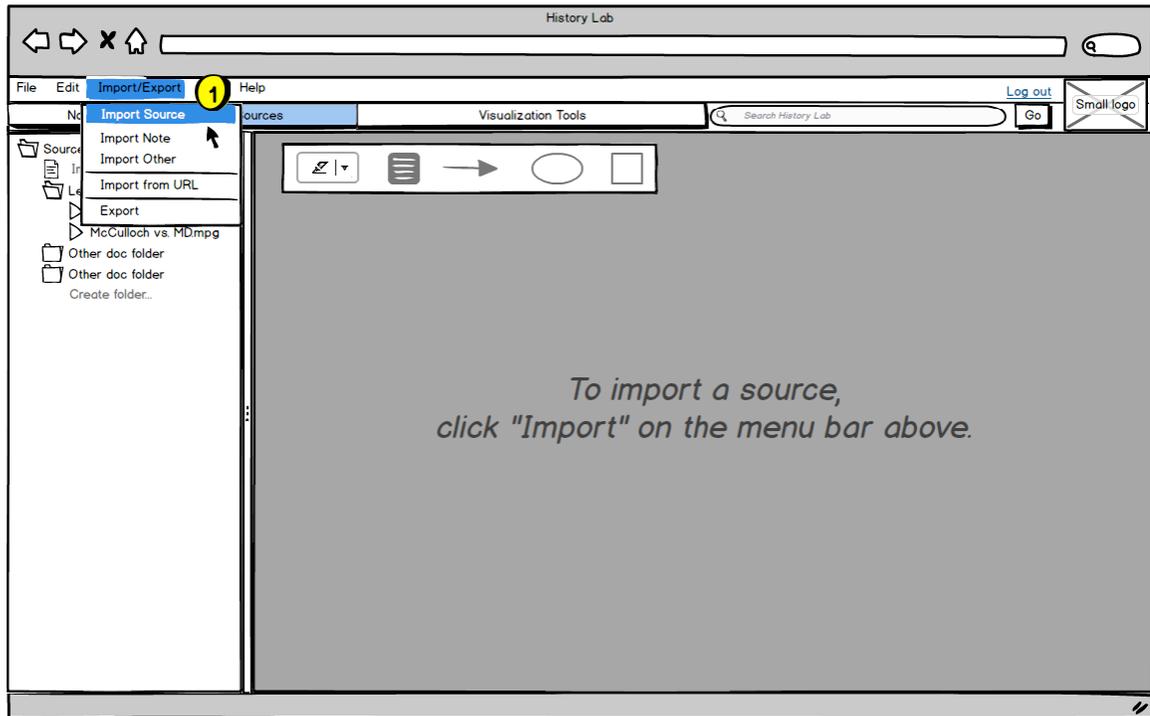
4. History Lab search results organized by type of resource



Notes:

1. Search results in HL are organized by the type of resource they are. A search for “John Jay” will display related Concepts, Notes, and Sources separated by a line.

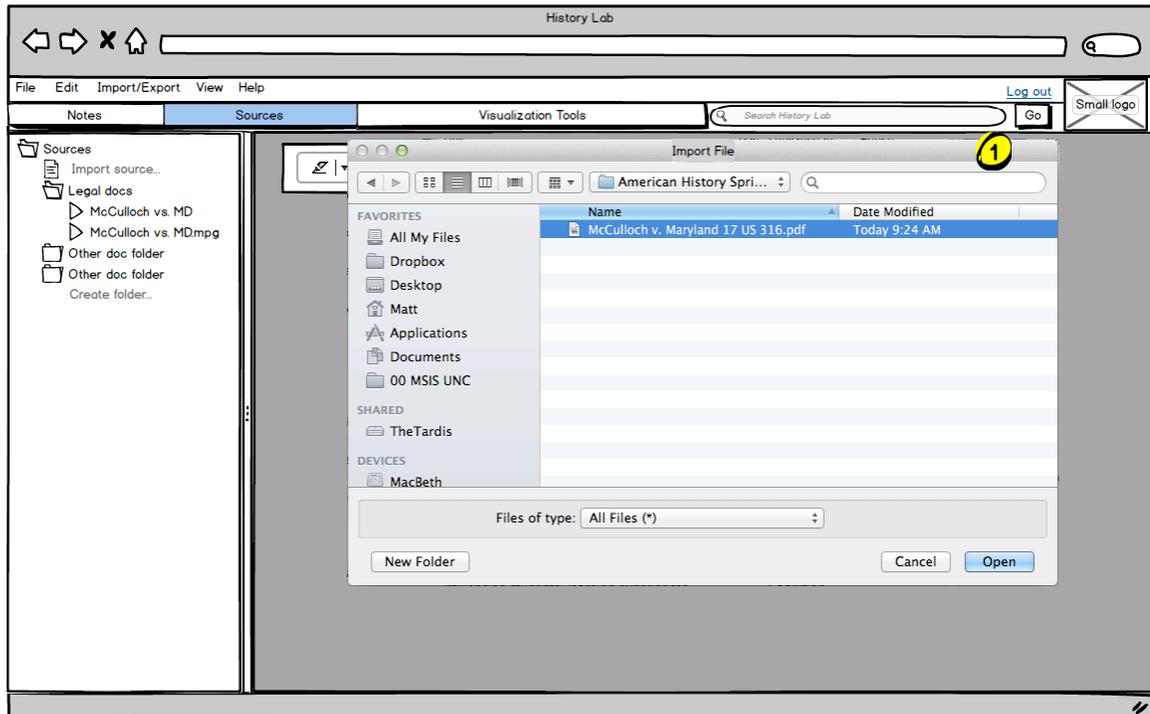
5. Sources: default state and Import/Export menu



Notes:

1. Import/Export menu. Options in the menu are divided by different types of tasks. In this case, Import Source is selected to show, along with the next wireframe, one possible interaction for importing a source (for the others, see interaction diagrams below). The other menu bar menus are sketched out below.

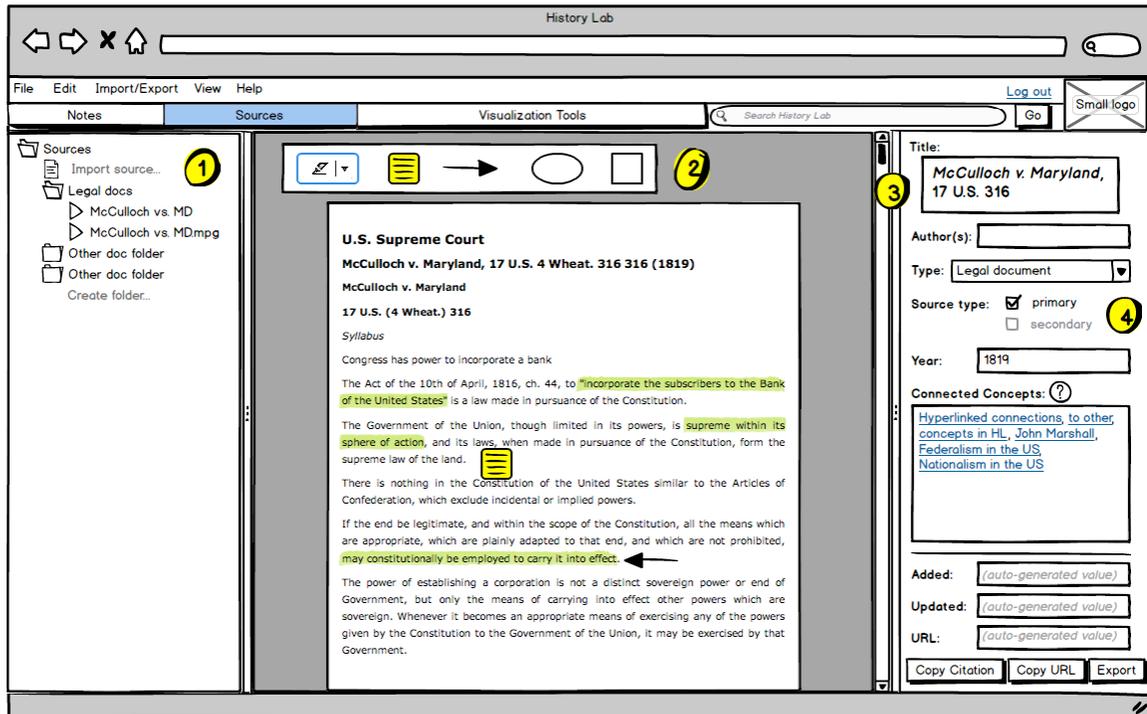
6. Sources: Import file system menu



Notes:

1. Selecting “Import Source” from the file menu or following one of the other paths to importing (see interaction diagram) calls up the system file menu (here depicted on Mac OS X). Here, users navigate their local system and then select “Open” to import the source into HL.

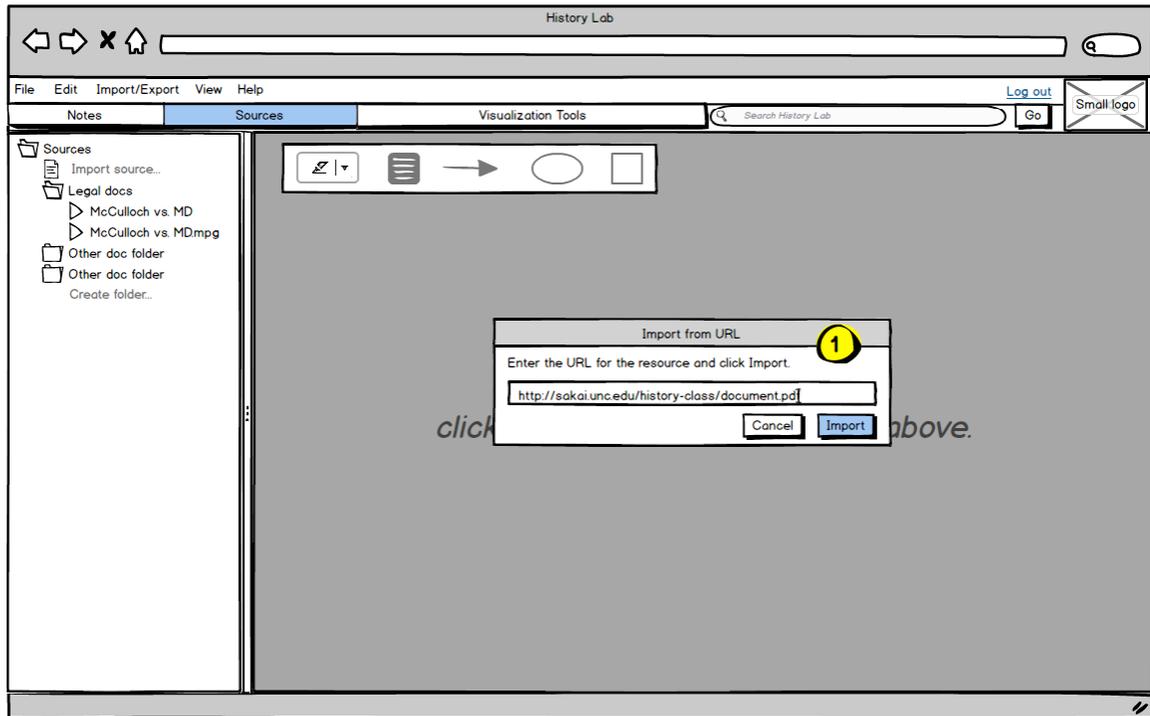
7. Sources: successfully imported primary source



Notes:

1. Sources file menu exhibits identical functionality to the other file menus in HL.
2. Annotation tools include highlighting text in multiple colors, writing brief in-text notes (split-screen with a HL Note is also supported), and drawing arrows, circles, or boxes.
3. The Sources metadata sidebar, which like the file folder sidebar can be contracted or expanded, allows the user to input basic metadata about a source, which also enables other functionality elsewhere in the application. For example, adding connected concepts enriches the representation of that concept in the system, and adding a year to the source will allow it to be “magnetically” at that year in the Timeline interface. At the bottom of the sidebar there are buttons that add those specified functionalities.
4. As will be shown in the next wireframe, different metadata is surfaced if the source is checked as secondary instead of primary.

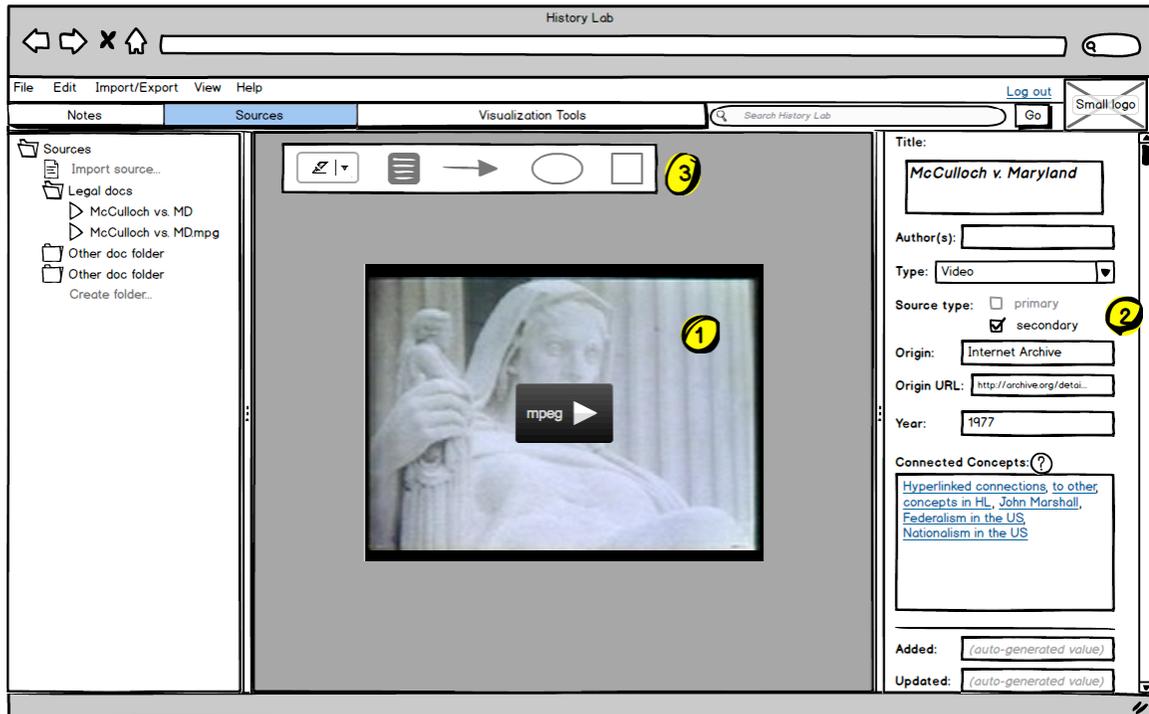
8. Sources: Import from URL menu



Notes:

1. Sources may be imported from a URI as well as from a local file system by selecting that option in the Import/Export menu. The URI must be well-formed and link to a supported file type (HTML, PDF, DOC, TXT, MP3, MP4, MPG) in order to be successfully imported.

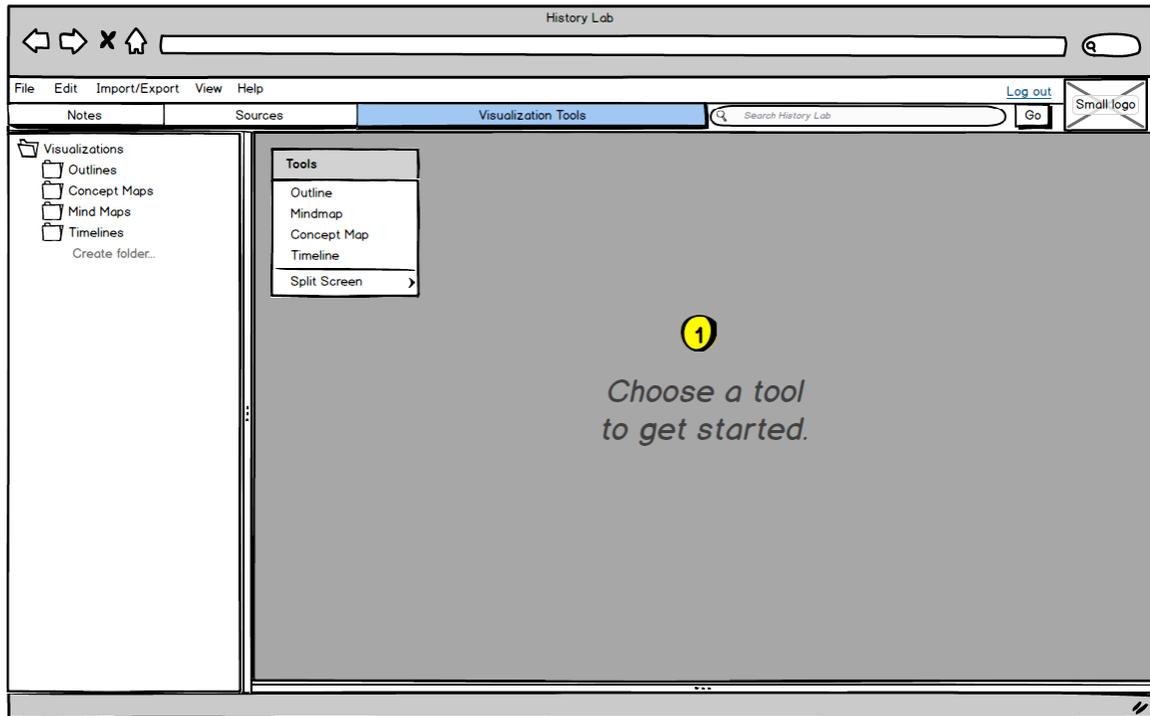
9. Sources: secondary multimedia source



Notes:

1. This MPEG file is sketched to illustrate that multimedia sources as well as textual ones may be imported into HL. HL should support common audio and video file standards.
2. As was mentioned above, if "secondary" is checked different metadata is surfaced for the source. This metadata could roughly be called "bibliographic": origin of the source could easily be a journal title. Origin URL is, as is the rest of the metadata, optional.
3. Since this is not a textual source, the annotation tools are disabled.

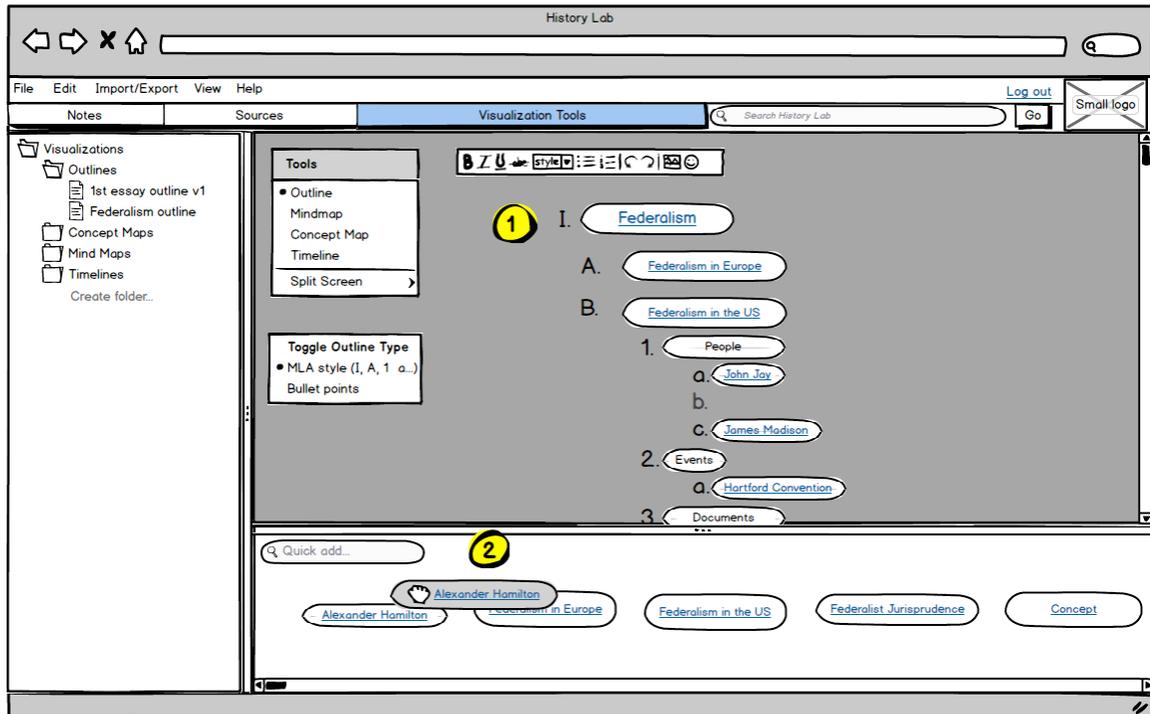
10. Visualization Tools: default screen



Notes:

1. Default view upon entering the Visualization tools area. Users choose a tool from the Tools menu in order to proceed.

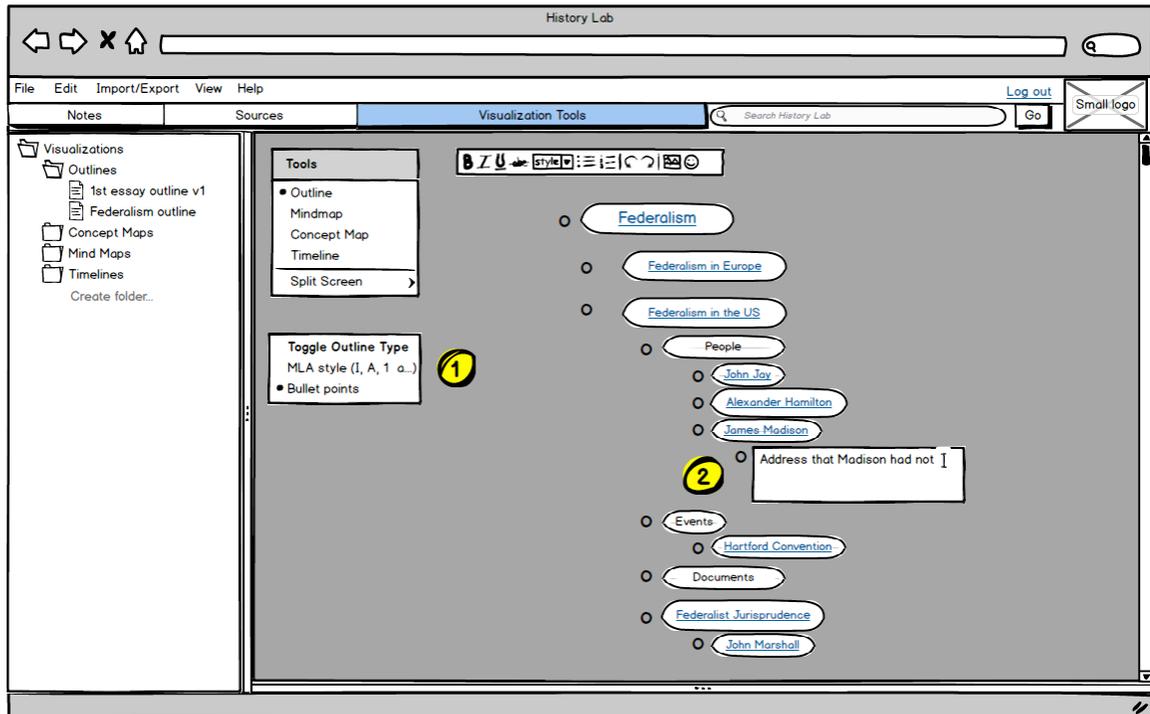
11. Visualization Tools: MLA-type outline



Notes:

1. This view shows an outline with an MLA-style outline, which can be toggled using the menu at the left. Concept nodes in the Outline view can be rearranged by dragging and dropping.
2. Concept nodes are added to the visualization by dragging them from the file browser at the bottom or typing their names into the "Quick Add..." search box. The file browser can be collapsed to allow more room to work. All visualizations are saved following customary design patterns, either selecting "Save" in the File Menu or typing Ctrl+S.

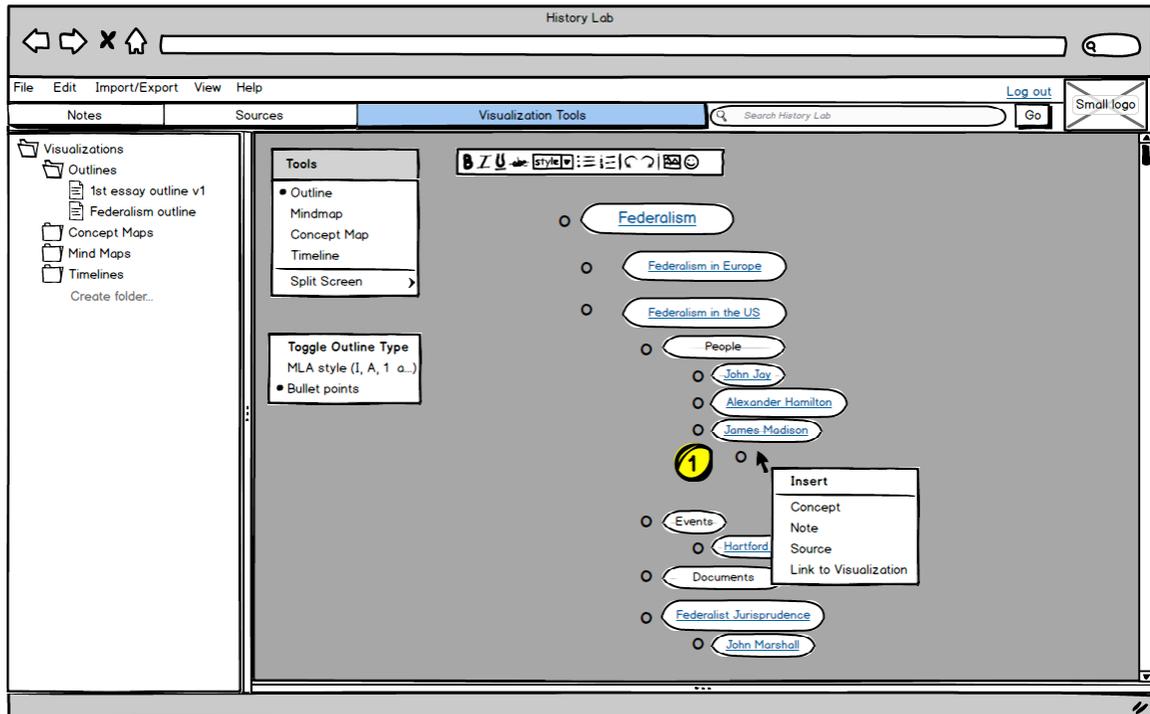
12. Visualization Tools: Bullet-style outline and typing in outline



Notes:

1. This illustrates how users may toggle between MLA and bullet point-style outlines depending on their preference.
2. Users may click and begin typing notes directly into the outline as well as adding HL Notes or excerpts from them, as will be shown below. The rich text editor tool above supports editing these notes.

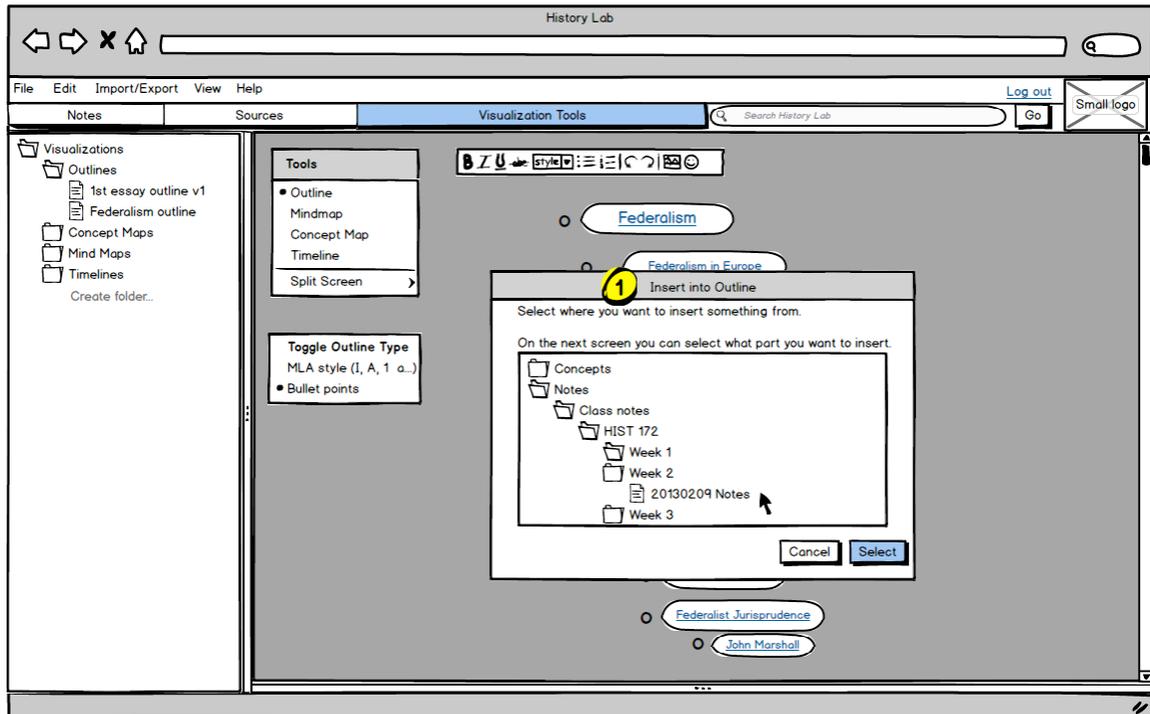
13. Visualization Tools: Insert into Outline context menu



Notes:

1. Right clicking in an empty outline space allows the user to insert a concept, note (or an excerpt of a note), a source, or a link to a visualization.

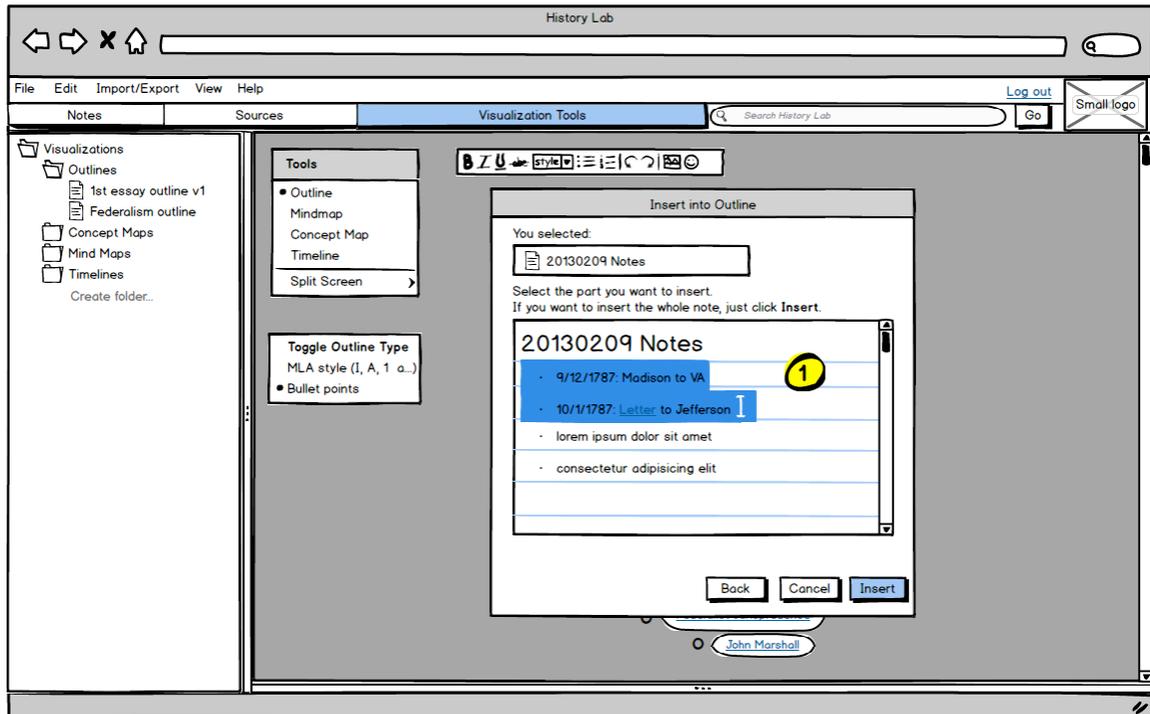
14. Visualization Tools: Insert into Outline menu screen 1



Notes:

1. Insert into Outline menu. Displays the full file structure of all files in HL. Clicking on a resource selects it and activates the next screen in the menu.

15. Visualization Tools: Insert into Outline menu screen 2



Notes:

1. Second of two parts of the process to insert a note into the outline. The note can be inserted in its entirety, or the user may select what parts of the note she wishes to include.

16. Visualization Tools: Insert into Outline successful state

The screenshot shows the History Lab interface. The main workspace displays a hierarchical outline structure:

- Federalism
 - Federalism in Europe
 - Federalism in the US
 - People
 - John Jay
 - Alexander Hamilton
 - James Madison
 - 9/12/1787: Madison to VA
 - 10/1/1787: [Letter to Jefferson](#) (from 20130209 Notes) **1**
 - Events
 - Hartford Convention
 - Documents
 - Federalist Jurisprudence
 - John Marshall

The interface also includes a left sidebar with a file explorer, a top menu bar (File, Edit, Import/Export, View, Help), and a toolbar with various visualization tools.

Notes:

1. This represents a successful outcome for highlighting a section of a note to insert into the timeline. A link to the full note is included for reference.

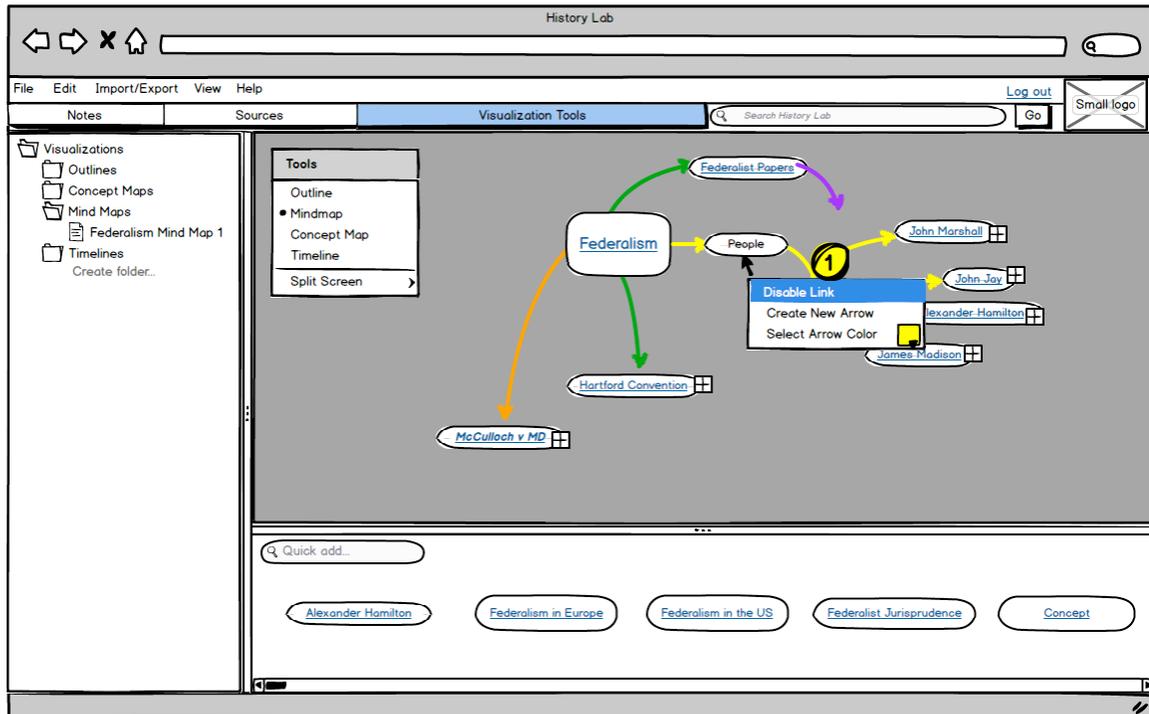
17. Visualization Tools: Mind map

The screenshot displays the History Lab interface for the Mind Map visualization tool. The central workspace shows a mind map with 'Federalism' as the root node. Six arrows radiate from this central node to other concepts: 'Federalist Papers', 'John Marshall', 'John Jay', 'James Madison', 'Hartford Convention', and 'McCulloch v MD'. A yellow circle with the number '1' is placed near the 'Federalism' node, and another yellow circle with the number '2' is placed near the 'James Madison' node. Below the main workspace is a 'Quick add...' search bar and a list of suggested concepts: 'Alexander Hamilton', 'Federalism in Europe', 'Federalism in the US', 'Federalist Jurisprudence', and 'Concept'. The 'Alexander Hamilton' concept is currently selected. The interface also features a sidebar on the left with a tree view of 'Visualizations' (Outlines, Concept Maps, Mind Maps, <Unsaved Mind Map>, Timelines) and a 'Tools' menu (Outline, Mindmap, Concept Map, Timeline, Split Screen). The top of the interface includes a navigation bar with 'File', 'Edit', 'Import/Export', and 'View' menus, and a 'Log out' button.

Notes:

1. Mind map visualization tool. Concepts are added to the visualization from the file browser below in the manner described above.
2. The small boxes with “+” signs on each concept node are clicked to create an arrow, which can then be dragged to any position around the node. Right clicking brings up the context menu, which allows the user to select color and perform a few other actions, as will be shown below.

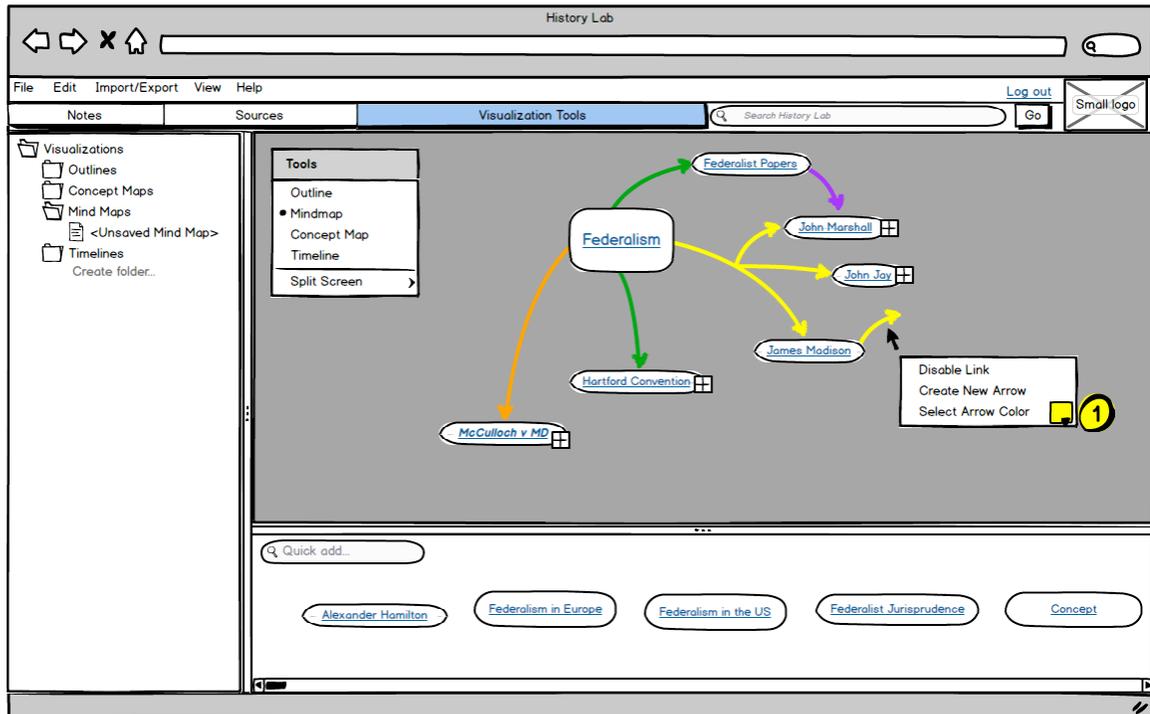
18. Visualization Tools: Mind Map context menu disable link action



Notes:

1. This shows the context menu that is invoked when the user right-clicks on a concept node. Clicking on "Disable Link," which is selected here, allows the user to disable the automatically generated URI for a particular node (see Design Brief above).

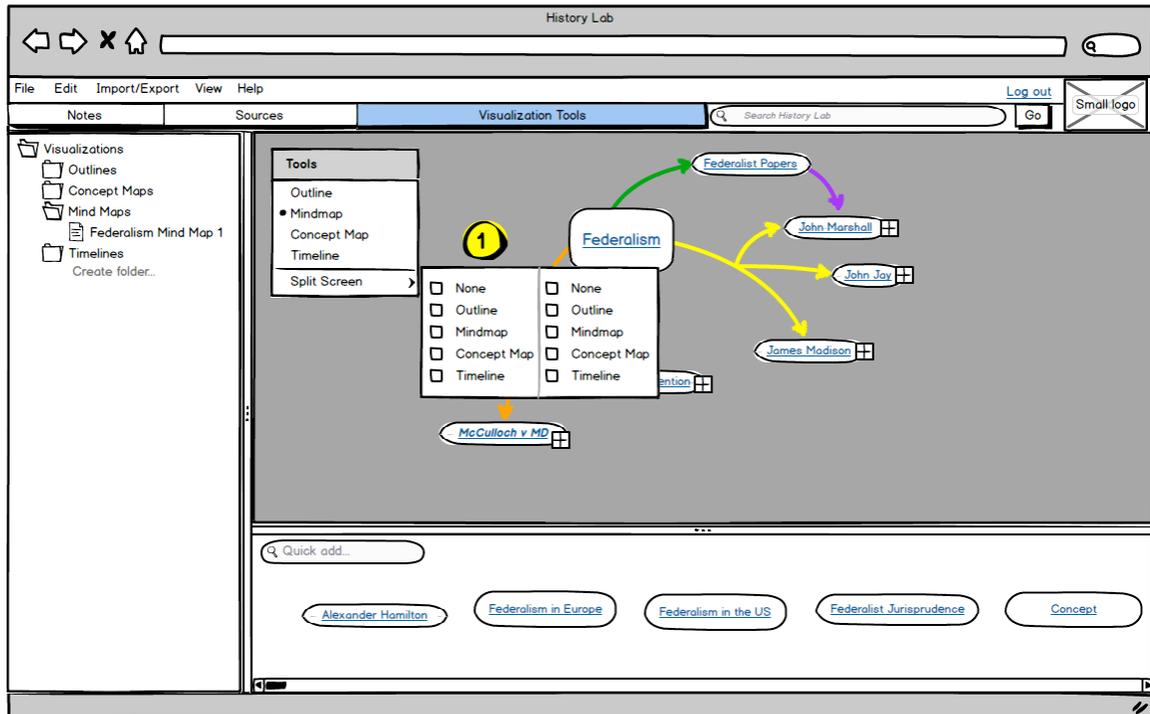
19. Visualization Tools: Mind Map context menu select arrow color action



Notes

1. This represents the user action of pressing the “+” sign on the “James Madison” concept node, which creates a new arrow. By clicking the color picker to the right of “Select Arrow Color,” the user may change the color of the arrow. Dragging the arrow changes its position and direction.

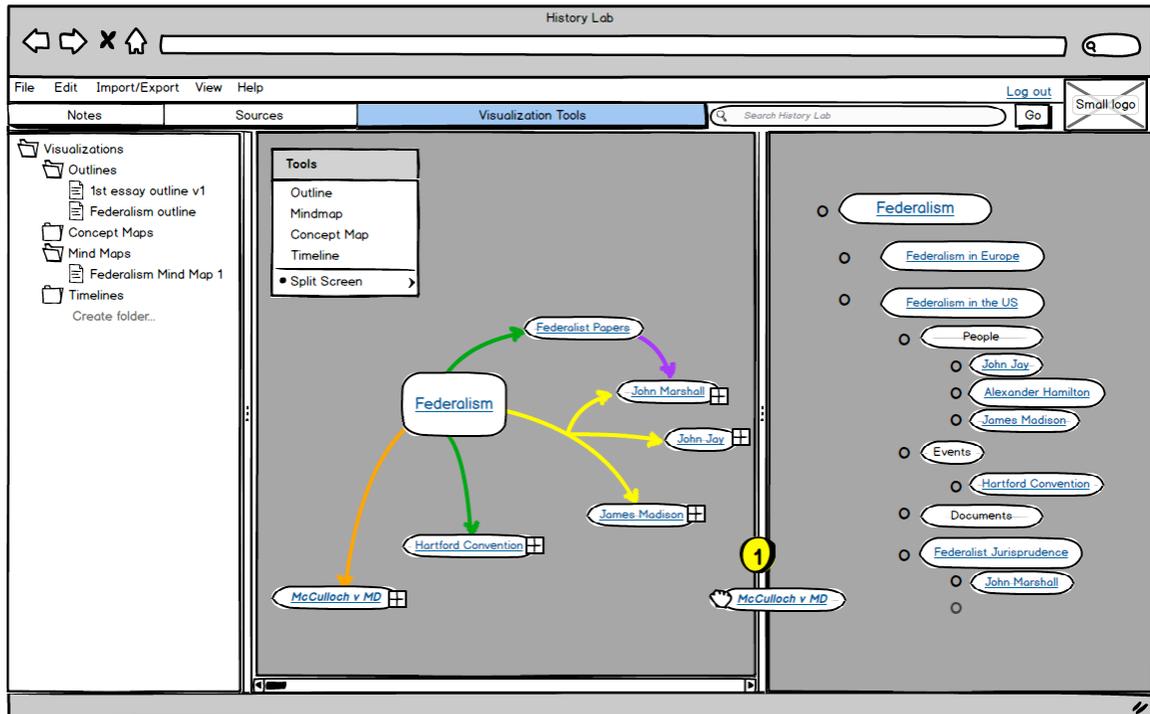
20. Visualization Tools: Split Screen selector menu



Notes:

1. Clicking or hovering over the Split Screen option brings up this sub-menu, which allows users to split the screen between any two combinations of visualization tools.

21. Visualization Tools: Example of split screen view (mind map/outline)



Notes

1. In this case, the user has chosen to split the screen between a mind map and an outline. Dragging a concept node from one visualization to another in the split screen mode constitutes a “copy-paste” action, hence why the “McCulloch v MD” node is still in the mind map. Both visualizations may be edited in this mode, but performing that particular action will not change the visualization from which the node is being “moved” unless the user decides to remove it.

22. Visualization Tools: Timeline with filter by country selected

Notes:

1. Time can be manipulated in the Timeline view in a few ways. First, it can be “zoomed in” and “zoomed out” using the “- +” buttons; for example, if you wanted to “zoom out” from the current view of 1740-1790, you could press “-” and the time units would become less granular.
2. Time can also be manipulated by dragging up and down on the timeline. If an user wanted to move to 1810, for example, she would drag up to show that date range.
3. As with elsewhere in the interface, the “Quick Add...” search bar allows users to quickly add a concept to a visualization if its name is remembered.
4. Swim lanes, or “filters,” can be added to the timeline by selecting the options of filtering events by country, concept, or project. This way, users can gain a sense for differences between nations, or between events, or between their own projects.
5. In keeping with the “zoom” metaphor for time, the user can select one of these options to “zoom” the time scale represented on the timeline as course-grained as millennium to as granular as month.

23. Visualization Tools: Timeline with filter by concept enabled

The screenshot shows the History Lab interface with the 'Visualization Tools' tab selected. The left sidebar contains a tree view of visualizations, including 'Federalism'. The main area displays a vertical timeline from 1800 to 2010. The timeline is filtered by concept, showing events related to Federalism in the US and Europe. A yellow circle with the number 1 highlights the 'Timeline Controls' panel, which includes a 'Filter by:' dropdown menu set to 'Concept (events, documents)'. The timeline shows the following events:

- 1800: Federalist Party, 1800 Election
- 1850: Morrill Land-Grant Acts
- 1900: League of Nations, Paneuropean Union
- 2000: Maastricht Treaty
- 2010: (No event shown)

Notes:

1. This shows how the timeline can be used to compare concepts in different circumstances, such as the relative development of Federalism in the US and in Europe.

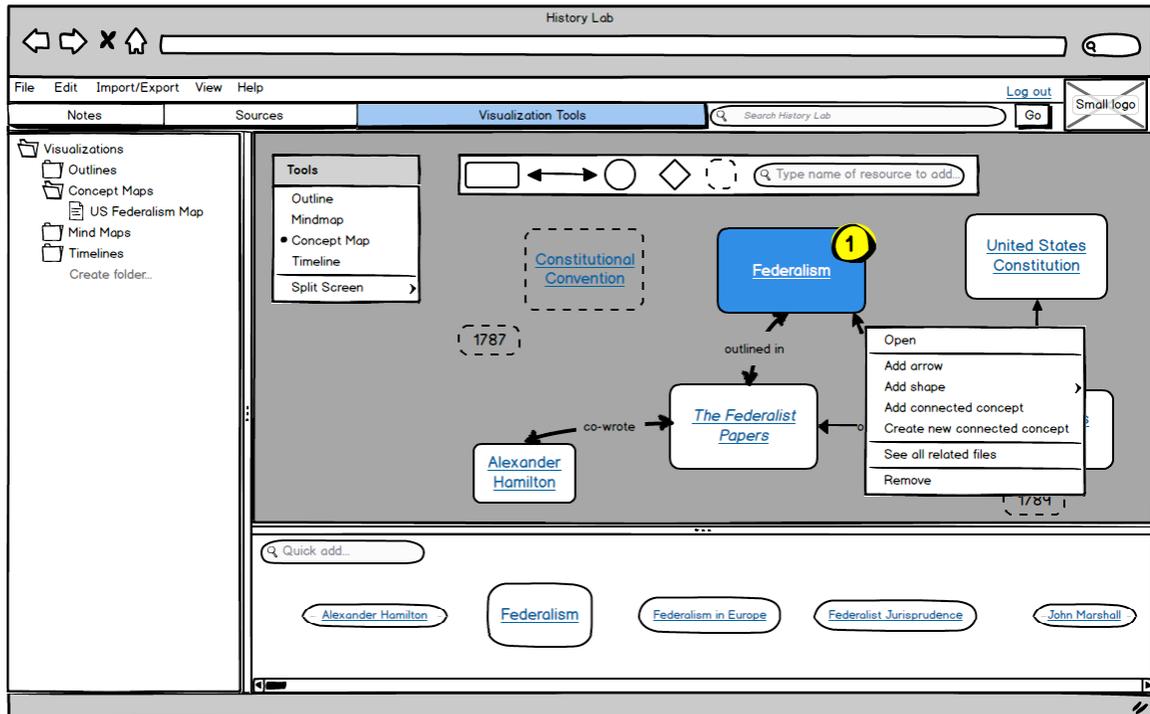
24. Visualization Tools: Concept map view

The screenshot displays the History Lab interface with the Visualization Tools section active. The left sidebar shows a tree view of visualizations including Outlines, Concept Maps, Mind Maps, and Timelines. The main workspace is titled 'Visualization Tools' and contains a 'Tools' menu with options like Outline, Mindmap, Concept Map, Timeline, and Split Screen. The central workspace shows a concept map with nodes for 'Constitutional Convention', 'Federalism', 'United States Constitution', 'Alexander Hamilton', 'The Federalist Papers', and 'United States Bill of Rights'. Relationships are shown with arrows: 'outlined in' from 'Constitutional Convention' to 'Federalism', 'part of' from 'United States Constitution' to 'United States Bill of Rights', 'co-wrote' from 'Alexander Hamilton' to 'The Federalist Papers', and 'opposed to' from 'The Federalist Papers' to 'United States Bill of Rights'. Annotations include '1787' near 'Constitutional Convention' and '1789' near 'United States Bill of Rights'. A toolbar at the top of the workspace shows various shapes and a search bar. A bottom toolbar shows a 'Quick add...' search bar and several concept nodes.

Notes:

1. The Concept Map tool can utilize the following shapes: rectangle, bidirectional arrows that can be configured to only have one head, circles, diamonds, and dashed rectangles.
2. In some concept map visual vocabularies, dashed rectangles are used to add perspective to the other concepts being represented. HL supports this behavior.
3. Users may create horizontal, vertical, or curvilinear lines in the Concept Map view by dragging the lines with the cursor. Lines are “magnetized” to concept nodes when the two meet.

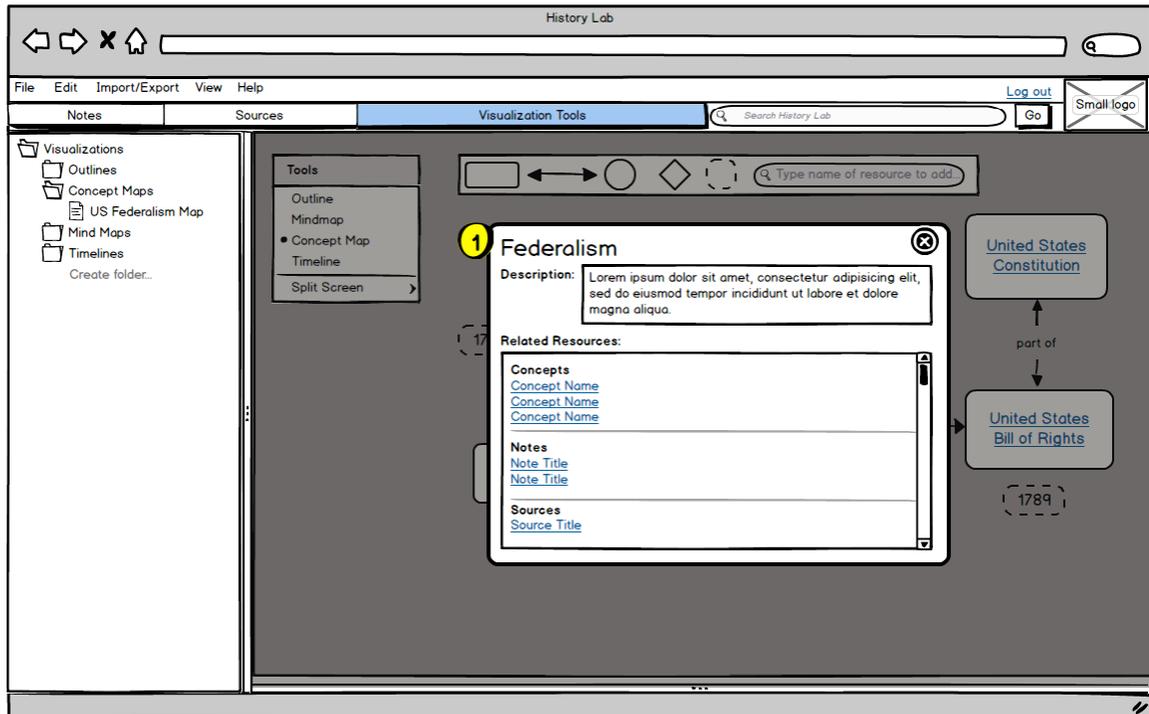
25. Visualization Tools: Concept node context menu



Notes:

1. This shows a concept that has been selected by right clicking. The context arrow affords a number of actions - the transition to the next wireframe supposes that the user clicks "Open".

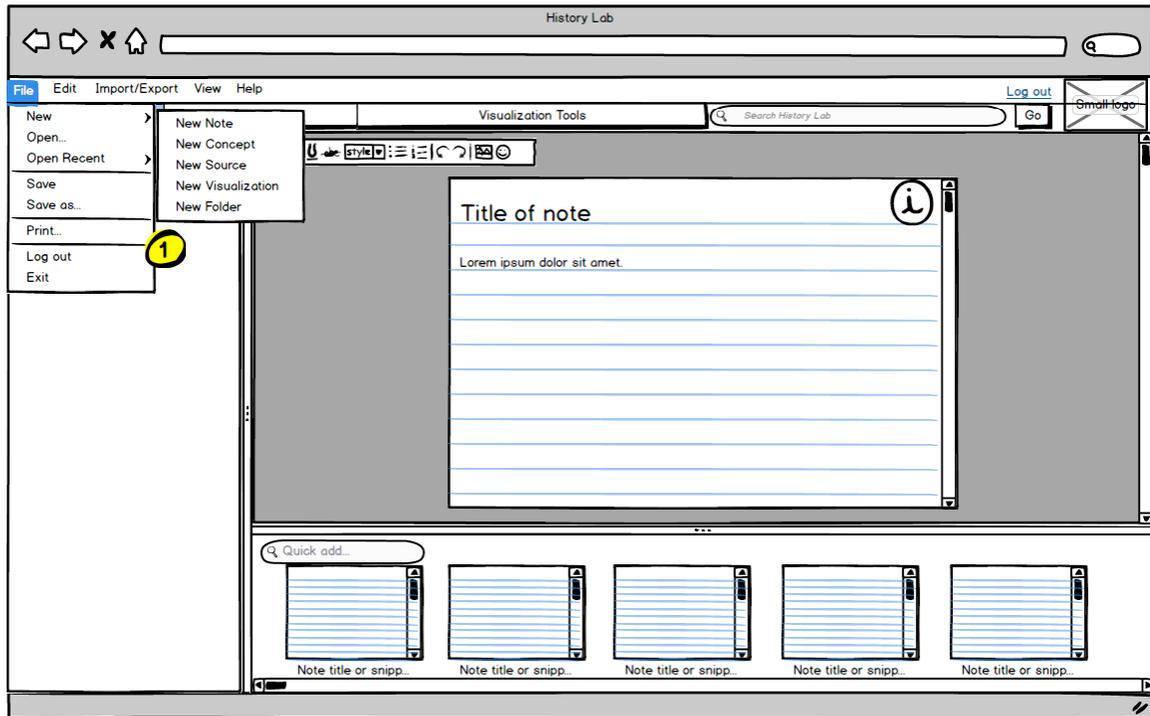
26. Visualization Tools: Concept detail view



Notes:

1. In the concept detail view, some metadata can be added to the concept ("Description") if the user desires and, more importantly, all the related resources to that concept are displayed by type. Creating a concept elsewhere in the application adds the name to the detail view shown here, but the user must come to this screen to add a description of the concept.

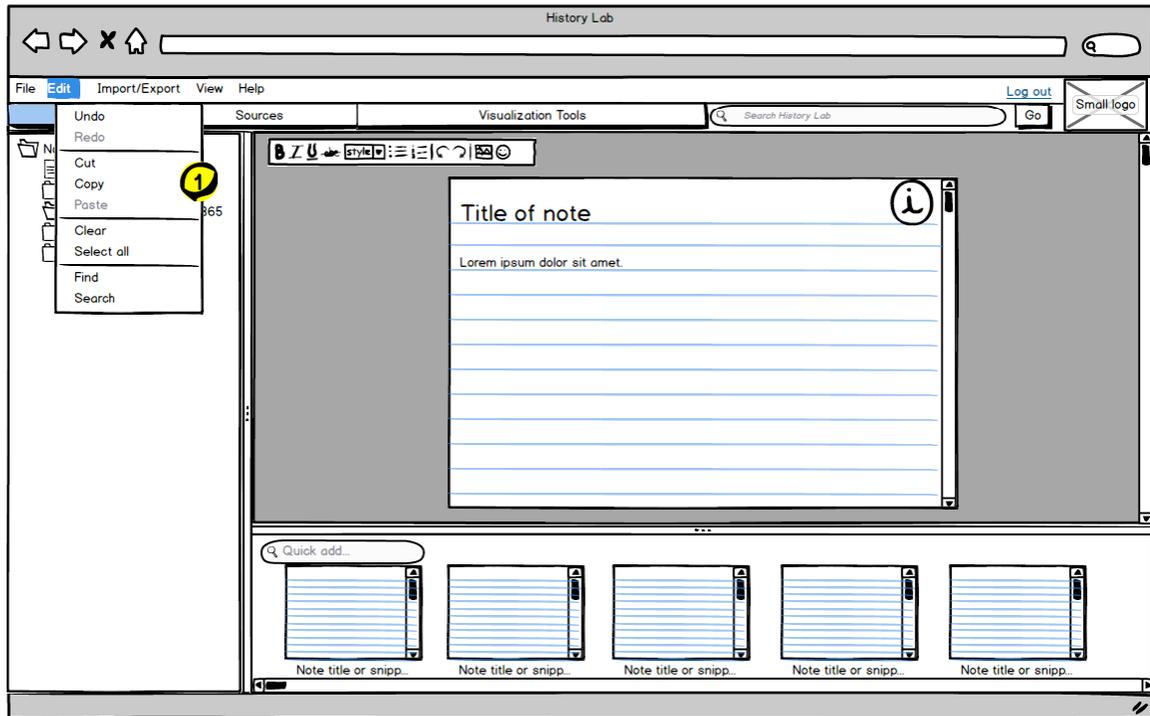
27. Menu bar: File menu



Notes:

1. The File menu, which persists throughout the application, affords standard functions. The “New” submenu allows users to pick which type of resource they would like to create. “Open Recent” keeps track of the last 10 resources opened by the user.

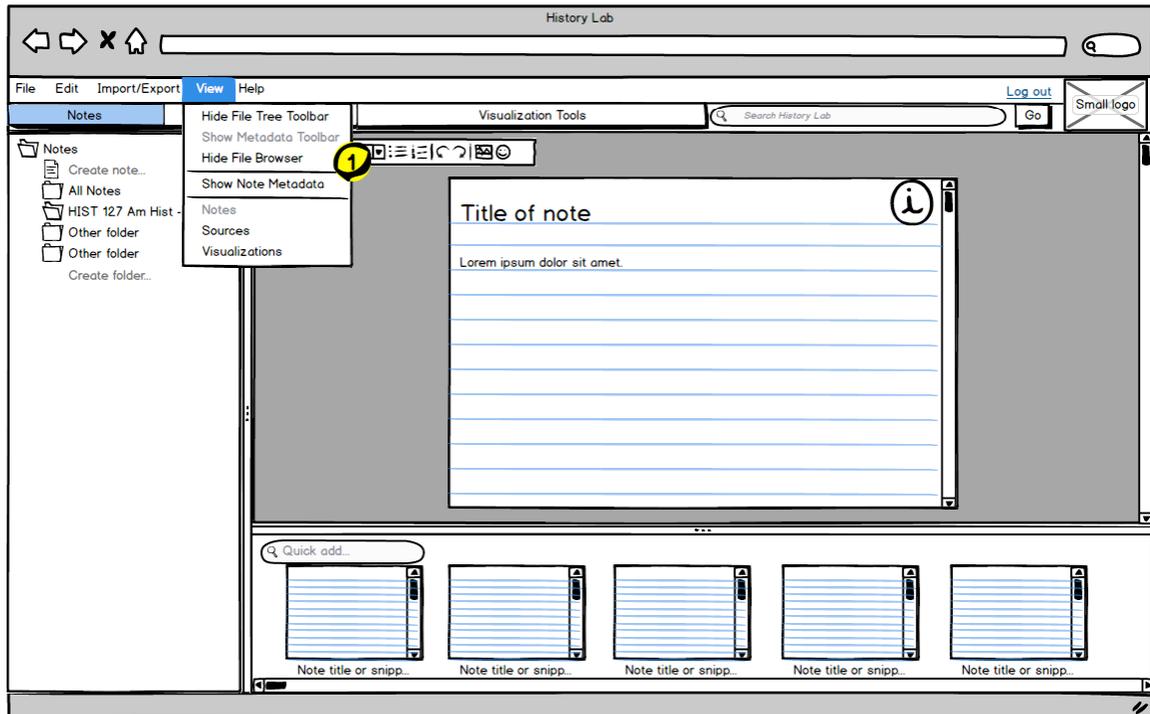
28. Menu bar: Edit menu



Notes:

1. The Edit menu, which persists throughout the application, affords standard functions.

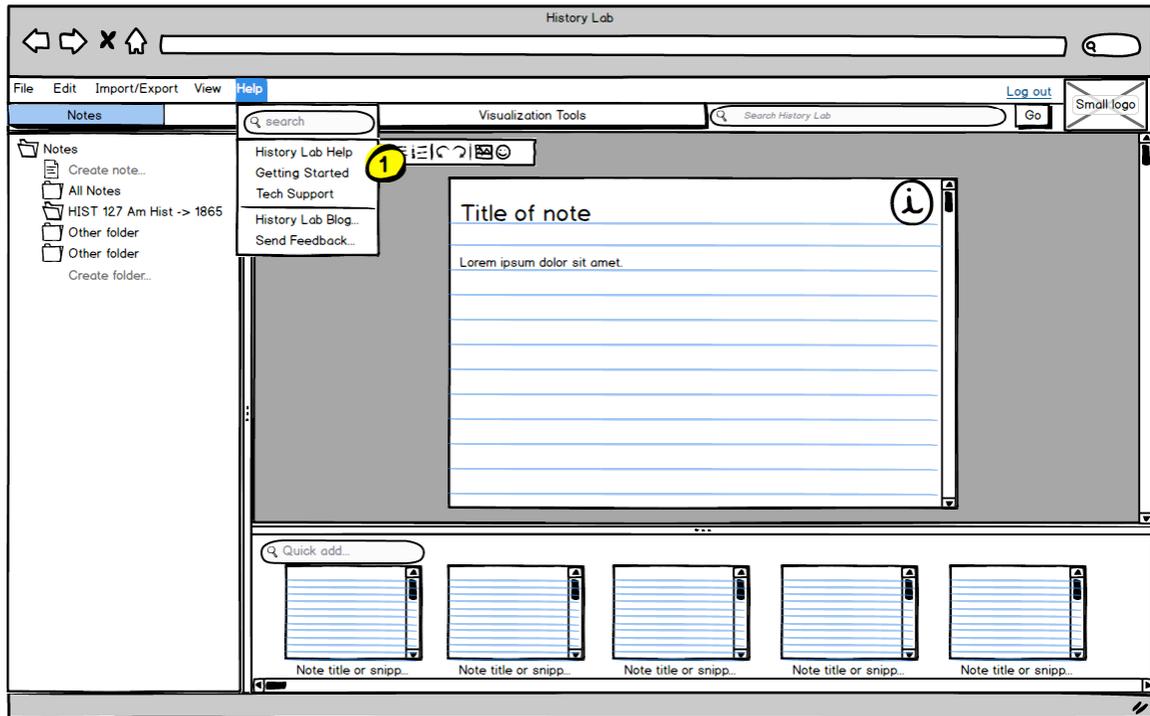
29. Menu bar: View menu



Notes:

1. The View menu, which persists throughout the application, affords standard functions. It is another method for collapsing or reopening the file tree, metadata, or browser toolbars. “Show Note Metadata” is only displayed as enabled in the Notes area when a note is currently selected. Users can also navigate between the three areas of the application via this menu.

30. Menu bar: Help menu



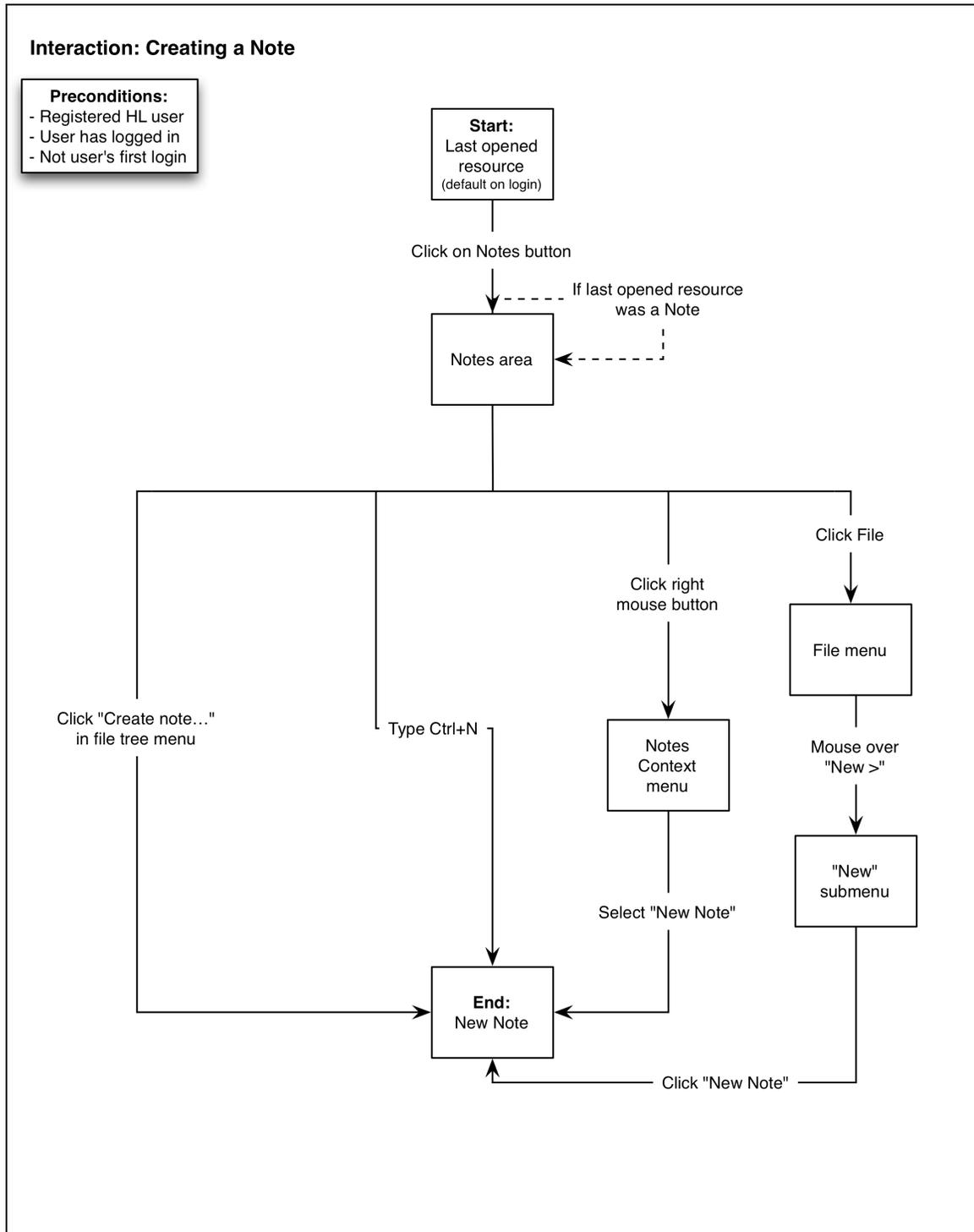
Notes:

1. The Help menu, which persists throughout the application, affords standard functions. "Search" allows the user to search the HL help database, which is not stored within the Web application but rather on the HL organization's Website. Users may also navigate to this help database by clicking "History Lab Help." "Getting Started" displays a series of tutorials for the application, and "Tech Support" directs the user directly to a troubleshooting page on the HL organization Website.

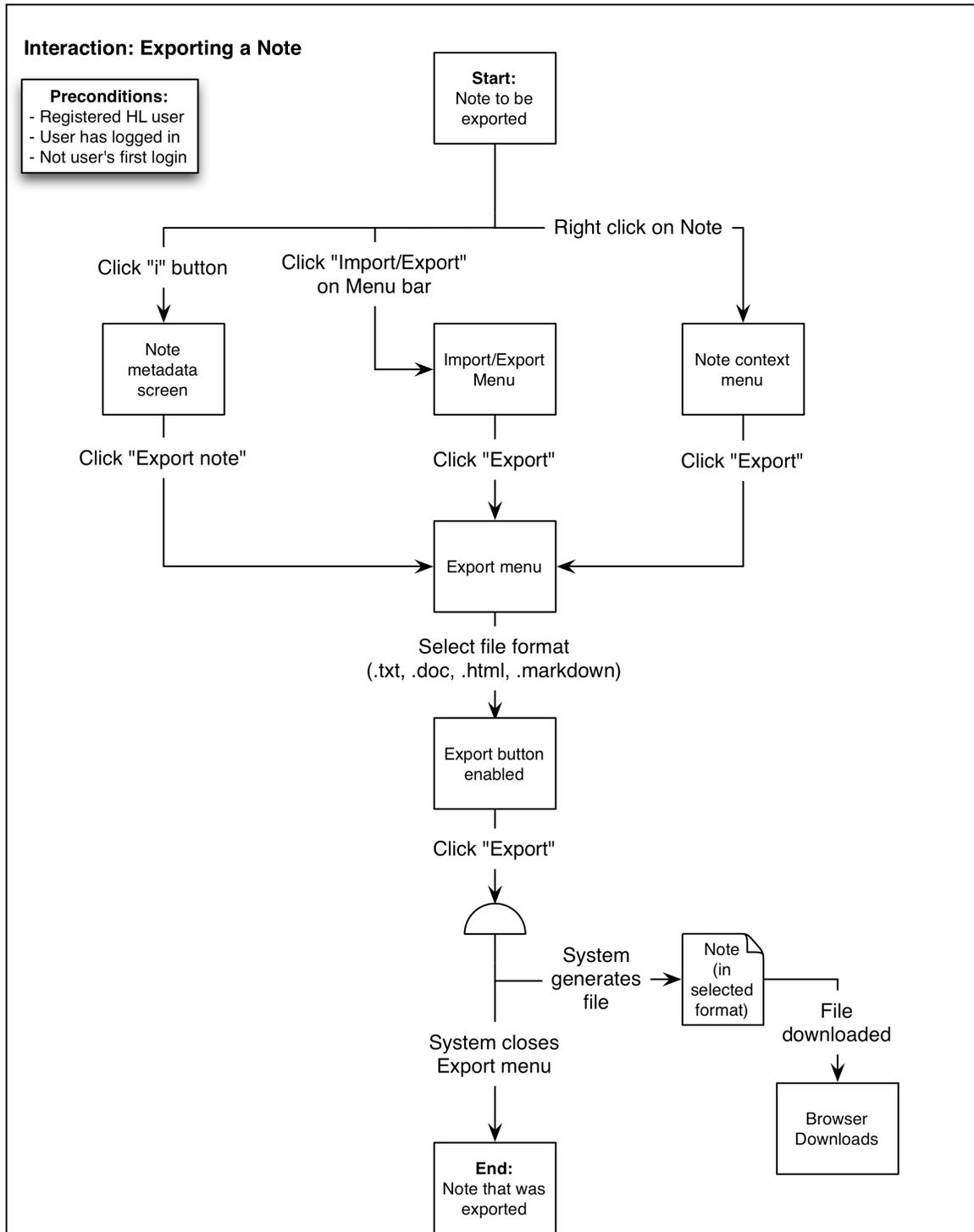
Interaction Diagrams

The following diagrams depict a number of different interactions in the History Lab system. They have been made using Jesse James Garrett's Visual Vocabulary for Describing Information Architecture and Interaction Design (<http://www.jjg.net/ia/visvocab/>).

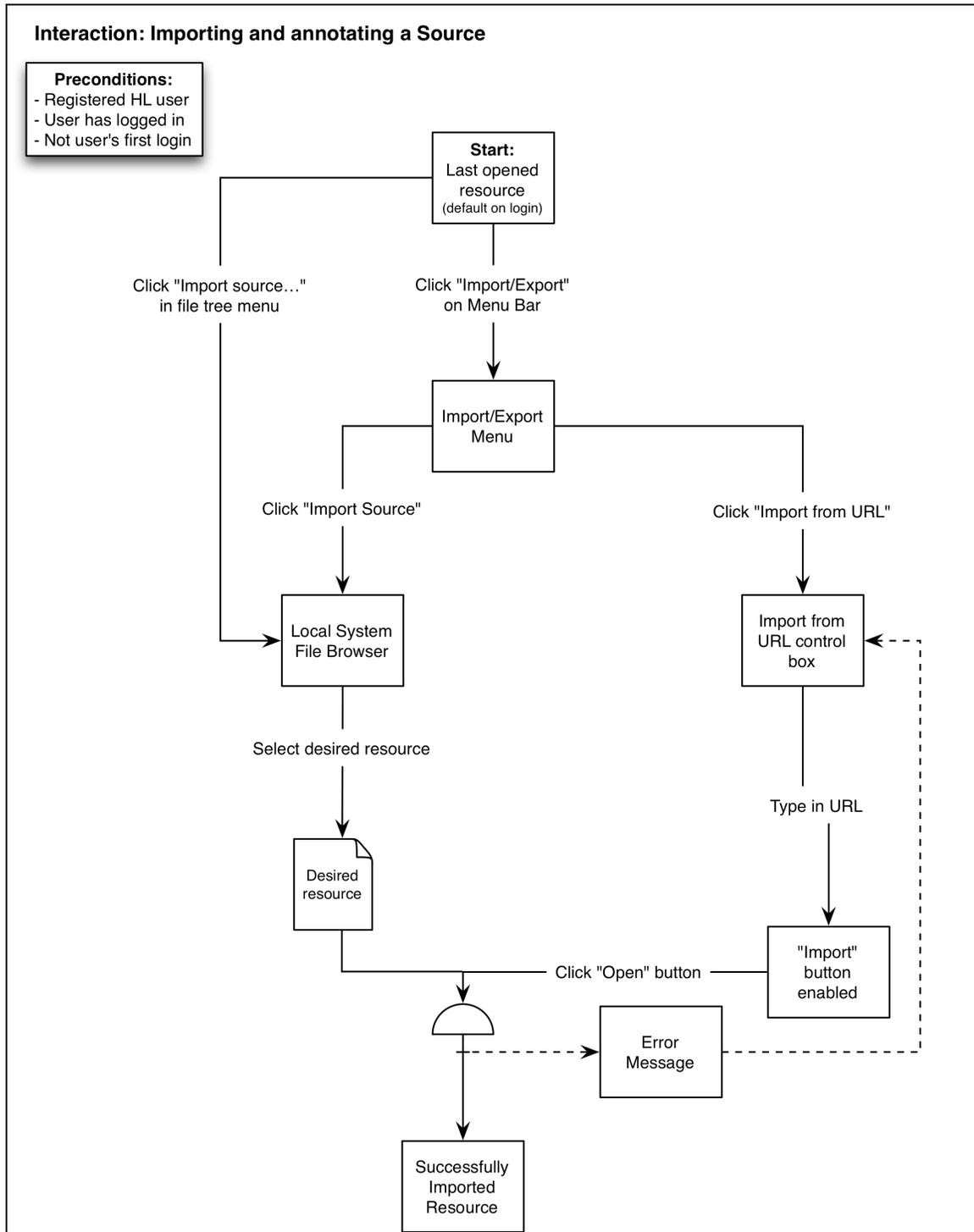
Interaction Diagram 1



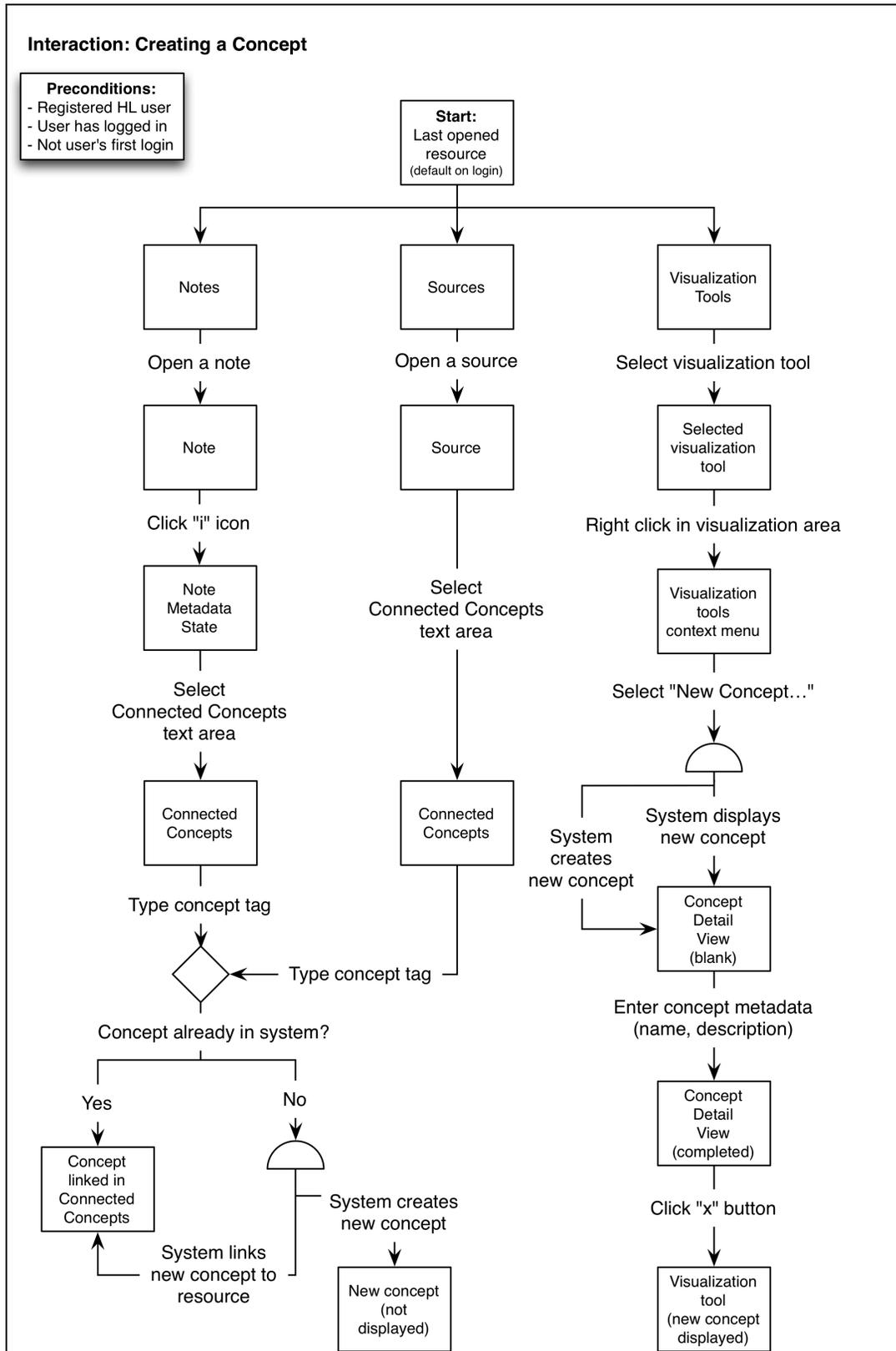
Interaction Diagram 2



Interaction Diagram 3



Interaction Diagram 4



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Appendix A: Assignment from HIST 276 discussed with interview subjects

(Included with the kind permission of the author, Dr. Sarah Shields)

History 276 First Essay

Four big questions guide our explorations of the Modern Middle East this semester:

- What is the nature of the state?
- Who belongs to the community?
- What role do outsiders play?
- What are the lives and livelihoods of the people like?

So far in class, we have learned (among other things) about foreign interventions in the Middle East, the perceived distinctions between various communities, reforms to state systems, and the lives of ordinary people in Egypt and the Ottoman Empire. For this assignment, you will need to take your understanding to a new level. Instead of just *explaining* what you have learned, we want you to *analyze* this new information.

Please connect two of these different central course issues for the period we have been studying so far. For example, one might contemplate the ways in which the changing nature of the state might change the definition of membership in the community, or how outside invaders might influence the nature of the state. In your essay, you must make an argument that connects two of these four issues. Your argument should be causative: changing one element changes another in some way. Please underline your argument.

This essay can rely on your course readings, class lectures, and discussions, but should not include outside readings. The (three double-spaced page) essay will be due at your discussion section meeting on Thursday, February 9 or Friday, February 10.

Plagiarism is a serious offense in the historical profession, and is unacceptable at this university. Any information or interpretation you are taking from someone else must be attributed to that person, so be sure to cite sources and to clearly indicate quotations. For more information on plagiarism, see writingcenter.unc.edu/resources/handouts-demos/citation/plagiarism. The provisions of the honor code are applicable to this as to other courses, and students will be expected to follow them.

The essays will be graded based on your ability to formulate a coherent argument and support it with evidence.

An “A” essay

- makes a coherent argument that responds to the question
- supports that argument well with appropriate and compelling evidence
- is organized coherently and written clearly
- has a strong analysis, an awareness of the “so-what” significance.

A “B” essay has an argument and supports it, but is lacking clarity, coherence, or strong analysis. A “C” essay lacks a coherent argument or adequate evidence to support the argument. A “D” essay lacks both, but still presents relevant information in partial answer to the question. Please remember that late papers will not be accepted.

Make sure that you leave enough time after drafting your essay to read it again and reflect on these questions:

- Identify your central argument. Underline it. Have you proved it with evidence? If you have not, what does your evidence actually prove? Should that be your argument instead?
- Outline what you have already written. Does the organization make sense?
- Find your evidence. Have you interpreted it so your reader can understand why you included it?
- Look back over your paragraphs. Does each one have a strong topic sentence?
- Reflect on the process of writing. When did you begin? Where did you write? What did you find most challenging? What do you like best in the current draft? What will you do differently for the next assignment? What will make the next assignment different? What can you work on in journal writing between now and then to improve your skills?

If you think your writing would benefit from assistance, please contact UNC's terrific Writing Center, writingcenter.unc.edu.

Appendix B: Focus Group Facilitator Guide

History Lab Focus Group Guide

Introduction

Once the group is seated, welcome the participants to the focus group. After the welcome, the facilitator should introduce himself and explain his role.

Hi everyone, welcome to the History Lab focus group discussion. My name is Matt Poland, and I am the principal investigator of the History Lab project. The purpose of our discussion today is for us to hash out some ideas for the skills and strategies that you, as expert historians, use when conducting historical research.

At this point, let's go over the information and consent form.

Explain confidentiality, voluntariness, the use of audio recording, and how the information they provide will be used. Pass out information and consent form.

Let's now review the information and consent form together [pass out the form and read aloud]... Do you all give consent to participate in this study? [Wait for response from everyone then continue]

Ask participants to introduce themselves – first name, year in program, main research interest.

Now that you've told me your names, I'm going to give a brief presentation about what the History Lab project aims to do.

Give brief (~5 min.) PowerPoint presentation about project.

So that's what History Lab is all about, in a nutshell. With that in mind, let's talk about how you do research and the types of features that you'd like to see such an application include.

Now let's go over a few ground rules. Since this is a seminar course, I'd like if this discussion felt like a seminar discussion normally would.

Go over ground rules: 1) one person speak at a time 2) cell phones on silent 3) respect each other's opinion, and 4) speak respectfully.

Begin Discussion

(Ask questions, using probes and prompts as necessary to engage all group members)

- When you're starting a new research project, what are the most important skills you use?

- How/when did you learn those skills?
- If you learned them in class or by doing classwork, what were the most effective methods for making them “hit home”?
- What piece of software do you use when you’re doing research? A Web browser and a word processor are a given.
- What (if any) physical artifacts do you use when conducting research? Why do you use them?
- Once you have gathered some sources, how do you start trying to understand the relationships between them?
- What (if any) visual methods do you use to understand the relationships between sources, concepts, or parts of your argument?
- How do you organize your research materials?
 - Do you use different file folders?
 - Do you save things on your local hard drive or using a “cloud” service?
 - Do you save multiple versions of the same documents?
- In this class, you’re learning to teach history. If you could use an application like History Lab in class, what sorts of things would you want it to help your students do?
- Here are a few features we’re thinking of including in History Lab. I’m going to name them off and give a quick description, and then we’re going to go around the table so I can get your reactions. I’m going to write them on the whiteboard, so keep them short and sweet. *[Name features for History Lab individually: mind maps, citation manager, PDF editor, note taking interface, etc.]*

End Discussion

Summarize main points of the discussion and ask participants to confirm their agreement or make corrections.

In conclusion, it seems like many of you perceive *[X, Y, Z]* as the most important skills that History Lab could help build and *[A, B, C]* as the most important features the interface could include. Does anyone want to make any corrections to that?

Thank all participants for sharing their thoughts, and be clear that the discussion has ended.

That concludes our discussion. Thank you everyone for your participation in this discussion. If any of you have questions about our discussion in the future, feel free to contact members of our research team using the contact information included on the Information Sheet that we've provided. Thank you!

Appendix C: Contextual Inquiry Interview Observation Guide

History Lab Contextual Inquiry Interviews Observation Guide

Note and record as many specific examples of the following as possible.

- ✓ Strategies for identifying sources
- ✓ Sourcing (primary and secondary)
- ✓ Corroboration of evidence
- ✓ Contextualization
- ✓ Use of course materials
- ✓ Synthesis of course materials with primary or secondary sources found on own
- ✓ Marking up behaviors of sources or course materials (digital or physical)
- ✓ Use of search engine or database
- ✓ Use of note taking tools
- ✓ Use of physical artifacts
- ✓ Use of information visualization tools (physical or digital)
- ✓ Use of citation management software
- ✓ Personal information management behaviors for materials
- ✓ Behaviors when using sources while writing paper
- ✓ List all software applications used during session

Appendix D: Paper Prototype Usability Evaluation Facilitator Script

History Lab Paper Prototype Usability Tests Introduction Script

[Deliver after IRB form completed]

Today, I'm going to be conducting a usability test of a paper prototype version of the History Lab application.

Have you ever participated in a usability test before? *[pause for answer, continue regardless]*

Basically, the purpose of usability testing is to measure how usable this application is, meaning how easy and intuitive it is for you to work through the tasks I give you.

Remember: I'm evaluating the application, not you. If you get lost or frustrated, it'll hopefully help me make this app better!

The paper prototype will stand in for the actual application in a Web browser. You will interact with it as you would on a computer, just using your finger as the cursor, transparencies as the keyboard, etc. We have pens, index cards, and Post-Its if you want to write or sketch any ideas. Your input is requested and appreciated!

I'll give you a series of tasks to perform using this application. I want you to perform the tasks the best you can, with minimal input from me. This should be as similar as possible to how you'd use this app if you came here on your own.

I will observe you working through the tasks – how you try to complete them, where you run into trouble, etc. – and I'll also ask you for your feedback as we go along and then at the end of the test.

When working through the tasks, think aloud as much as you can. Let me know what you're thinking, what you're looking for, that sort of thing. I will have you read the tasks aloud so I can easily keep up with you. Try to stay on-task as much as you can, but if you see something you find interesting, let me know and if there's time we can explore further. When you're ready to move on to the next task, just let me know.

If you get stuck completing a task, say so. I might not assist you at first because one of the things I'm testing is how easy it is to get out of difficult situations. But, when you feel like you've exhausted all reasonable resources and can't finish, let me know.

For this test, my assistant and I will be logging observations and your comments. We will be recording audio and video of the test as well. These recordings will be used as a reference as the design process goes forward, and will only be seen in full by me. Extracts from my notes and the AV recordings may be used in the final recommendation document and/or presentations.