# Working Towards the Ideal Search History Interface

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## Abstract

Searching on the Web has become an essential part of learning, and bookmarking is a way to remember relevant and interesting sites. Even though bookmarking systems have been around since the dawn of the Web, they have not evolved much in the last 20 years. In this paper, we introduce LogCanvas v2, a new and extended design of the search history interface, intended to capture the search and learning process in our Learnweb educational platform. Our new interface focuses on users' queries rather than just the browsed webpages, enabling users to reconstruct the searching, browsing and learning process. Also, it helps them to re-find the information they need and annotate the useful information. We hypothesize that search learning with annotation capabilities can be achieved in our platform. We finish the paper with a detailed description of a learning scenario and the benefits of the learning process in our platform.

## Keywords

Search history visualization, information re-finding, collaborative search

## 1. Introduction

Searching to learn is increasingly viable as more materials become digital and get published on the web. Learning searches involve multiple iterations of queries and return sets of objects that require cognitive processing and interpretation. During this process, searchers' interactions with search systems is generally recorded as search history logs. Studies found that as many of 40% of users' search queries are attempts to re-find previously encountered results [1]. Further, a survey of experienced Web users showed that people would like to use search engines to re-find online information, but often have difficulty remembering the sequence of queries they had used when they originally discovered the content in question [2]. In this scenario, search history can be an important resource for both individuals and collaborative searching groups to preserve and recall their searching and learning process.

Search logs record explicit activities of searchers, including the submitted queries and the clicked answers (search results). The history interface in current search engines displays the issued queries with corresponding visited webpages in the form of a URL list. However, there is a research question that might arise: *is the current history interface well-designed for the user experience in searching to learn scenarios, when users want to revisit certain webpages to review what they have learned during the searching process?* To answer this question, we carried out a comparative study of user experience in using history interfaces of popular search engines to review webpages while searching to learn (see Section 3). Based on the results of this investigations, we propose a new design for the search engine history interface, the LogCanvas v2. In contrast to the existing interfaces, the LogCanvas v2 focuses more on the users' searching and browsing path, such as how users issued queries and navigated to certain search results; which enables them to reconstruct their searching, browsing and learning process to help them re-find information quickly.

This paper is organized as follows: in Section 2, we provide an overview of related literature about existing search history visualization platforms. In Section 3, we discuss users' experience in using current search engines' history interfaces and their feedback. In Section 4, we describe our design and the workflow of the LogCanvas v2 history interface. An experimental scenario in which we plan to evaluate Learnweb is presented in Section 5. Finally, we draw our conclusions in Section 6.

## 2. Related Literature

Research on searching as learning and archived data visualization is relevant to our work, as it concerns searching platforms that support learning during searching, preserving and visualizing users' search histories.

## 2.1. Searching as Learning

Some existing studies have focused on the correlation between learning and users' searching progress. Researchers such as Vakkari [3] and Wildemuth [4] have explored the role of information searching in learning, and the factors or concepts related to searching as learning. Freund et al. [5] found that reading could be the core component of users' searching progress, and they studied the text on the impact of learning outcomes.

Extensive studies have also been conducted on searching systems or techniques in supporting learning. Stange et al. [6] investigated users' searching progress and found that individuals could integrate their knowledge gains into the searching process through concept maps, and understand the relationship between learning, sense making, and information seeking. Egusa et al. [7] revealed that the visualization tools in search engines, such as concept maps, could be used to evaluate evolvement of users knowledge structure and search behaviours. Jansen et al. [8] classified searching as learning tasks of users to verify whether there were specific factors in the learning process. Moreover, they found that web searchers relied more on their knowledge and information needs, while the searching was used mainly to check facts.

There were also studies focusing on how the performance of searching as learning can be improved by assistance of new models, systems, and other methods. Saito et al. [9] designed a searching platform that supports users thinking activities. The platform visualized learners' searching process and promote their thinking by comparing learners' searching as learning processes to those of other searchers. Bah and Carterette [10] created a system to support continuous searching as learning. The system firstly created typical pseudo-documents and then sorted information from retrieval results according to how closely it matched the typical document.

Existing studies have shown that learning is embedded in the searching processes. However, these works are focused more on developing dedicated systems and single-user scenarios, and more studies are needed that focus on searching as learning within search engines and more complex scenarios such as collaborative web search.

## 2.2. Archived Data Visualization

One of the first works regarding developing an interface for collaborative learning was published in 1996 by Michael B. Twidale and David M. Nichols in their work "Interfaces to support collaboration in information retrieval" [11]. The key idea was to develop an interface, which allows to collect the user's queries and their results, and after that to visualize the search process.

A more recent solution is SearchX [12], which is based on the search engine Pineapple Search[1]. SearchX[2] is a search system, which includes a collaborative search interface. People can collaborate in groups during the searching process by using different widgets, such as shared query history with the groupmates, bookmarks of useful information and sites which can be seen and used by other people in the group.

Systems such as popHistory [13] and Warcbase [14, 15] save users' visit data, based on which they can extract and display the most visited websites to users. History Viewer [16] tracks processes of exploratory search and presents users with interaction data to enable them to revisit the steps that led to particular insights.

Information re-finding tools such as SearchBar [17] provide a hierarchical history of recent search topics, queries, results and users' notes to help users quickly re-find the information they have searched. The system Personal Web Library helps users to understand their web browsing patterns, identify their topics of interest and retrieve previously visited webpages more easily [18]. Some other tools, such as SIS (Stuff I've Seen) [19], collect users' personal data, such as email and docs, and offer a diary list to help users quickly locate past events or visited web-pages based on dates. Some recent works [20, 21] investigated how to combine context analysis and information re-finding frameworks to remind users about historical events according to users' current context. Logcanvas [22] and Log-CanvasTag [23] provided a graph-based search history visualization helping users re-construct the semantic relationship among their search activities.

In collaborative search systems such as Coagmento [24] and SearchTogether [25], visualization of search history usually involves multiple users' search logs, including their search queries, and bookmarks. Interfaces of this kind display search histories separately according to data types or categories and support notepad functions which allow group members to share an experience.

By contrast to the systems described above, Log-Canvas v2 provides a visualization of the search sessions based on a timeline and tags the activities of users. Our aim is to help users to reconstruct easily their

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[1]https://www.pineapplesearch.com/
[2]https://github.com/felipemoraes/searchx

**Table 1**

A comparison between functions of Pocket, Google, and Learnweb

| Items | Learnweb | Pocket | Google |
|---|---|---|---|
| Searching scope | i. Private Resources (bookmarked or archived) ii. Topical Groups iii. Archived documents | i. Private Resources (bookmarked or archived) | i. Private Resources |
| Searching method | Full-text search (Bing API & Solr) | Keyword search or URL (exact matching) | Full-text search |
| Bookmarking method | Bookmarking guideline within platform | Bookmarking guideline in form of plugin | Bookmarking guideline within platform |
| Operations on bookmarked/archived resources | i. Filter ii. Rate (i.e. add type) iii. Tag iv. Comment | i. Filter ii. Rate (i.e. add favorite) iii. Tag iv. Search by tag | — |
| Organizing bookmarked/ archived resources by: | i. Topical groups ii. Folders iii. Tags | Tags | Folders |
| Support for learning | Collaborative searching and history sharing | Annotation with content on saved webpages | — |

searching process and re-find an information which they searched for.

# 3. An Investigation of Web History Interfaces

In this section, we compare history-related functions in three searching platforms: Google Search, Pocket, and Learnweb[3]. Learnweb is a web platform, developed for searching, collecting and sharing educational resources [26, 27]. In order to understand what might be missing in the current version of Learnweb, we investigated which functionalities are offered to the users from their search histories. As shown in Table 1, we compared the history-related functions of the three platforms from different perspectives: (i) history retrieving (i.e. searching scope, searching method), (ii) bookmarking (i.e. bookmarking method, operations on bookmarked resources, and bookmarking organizing method), and (iii) support for learning.

*History retrieving* Being able to review queries and search results quickly is considered as a highly useful feature of a history interface. In all the three reviewed interfaces, users can review their search histories (i.e. queries, search results and bookmarked resources). However, there are still differences as regards history retrieving scope and retrieving methods.

1. Searching scope. Since Learnweb was developed to be a collaborative searching and archiving sys-

tem to support users independent or collaborative search, its history interface was designed to support varied retrieving scopes including: **private resources**, wherein a user's individual searching records can be found; **topical groups**, wherein queries and search results of members in the user's collaboration group can be found; **archived documents**, wherein the search results archived by the user can be found. On the contrary, Pocket and Google Search support retrieval within users' individual searching records.

2. Searching method. In the Learnweb platform and in Google Search users can do a full-text search to retrieve histories. Pocket only provides keyword search and search by URL (exact matching).

*Bookmarking* By applying the "bookmark" function during searching, users can mark important search results for quickly information re-finding or reviewing in the future. In the three analysed platforms, bookmarking methods and supporting operations on bookmarked resources are different.

1. Bookmarking method. In Learnweb and Google Search, users can directly bookmark search results through a pop-up guideline within the platform. When using Pocket to store webpages, a Pocket plugin should be added to the search engine.

2. Operation on bookmarked/archived resources. Using the Learnweb platform and Pocket users can edit metadata of archived resources including ratings, tags and comments. Besides this, in
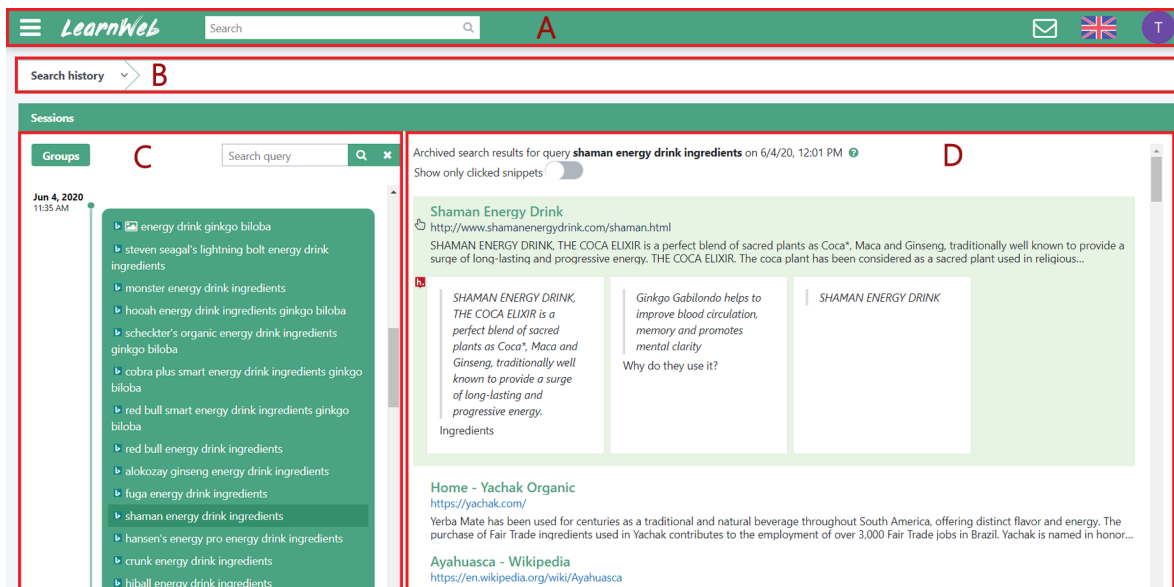
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[3]https://learnweb.l3s.uni-hannover.de/

**Figure 1:** LogCanvas v2 interface displaying the search history results.

Pocket users can select and highlight the text of a resource and review all the highlights. In the Chrome browser, users can only change the file name and the file location.

3. Organizing bookmarked/archived resources. A possibility of organizing saved resources is present in all three interfaces. In Learnweb, a user can organize the resources by topical groups, folders and tags; in Pocket by tags and in Chrome by folders.

*Support for Learning* The Learnweb platform can facilitate distance learning. By using web resources, students can learn asynchronously from any place with an internet connection. According to our analysis, Learnweb is outstanding in terms of supporting learning during searching. It provides learning-related functions that allow users to work in topical groups, join specific courses and perform data analysis of their work or their groupmates [28]. On the other hand, we noticed that Pocket, as a history manager, supports annotating for articles or videos in bookmarked webpages where users can directly add their comments or personal ideas to the saved resources. This kind of interaction between users and search history is shown to be effective in supporting learning during the information searching/re-finding process [29]. Thus, we explored the possibility of adding a similar function to Learnweb (as described in Section 4).

Moreover, in Learnweb team-based learning (TBL)

and project-based learning [30], short term or long term, can be achieved. In order to achieve TBL, students should work in small groups, be accountable for the work they are performing, and receive feedback [31]. In order to achieve the maximum impact in learning, the groups should work on different parts of the same problem, which demonstrates a useful concept and report simultaneously. Focused on these goals we developed a learning scenario to test our platform (Section 5.1).

## 4. The Design of LogCanvas v2.0

Having a better knowledge of existing solutions, we started to design a new search history interface to be integrated into the Learnweb platform.

### 4.1. Overview

The LogCanvas v2 search history interface is used to recover the search history from the Learnweb platform. The interface was inspired by different web-browsers, such as Google Chrome, Firefox and Safari. The latest version of the interface focuses more on the users' queries and has several new features in comparison to the previous versions.

In order to record the searching process, first of all, users have to perform some search queries in Learnweb. After registration and login into the platform, the user

**Figure 2:** An external webpage with an opened Hypothes.is client. By clicking in the first webpage "Shaman Energy Drink" in Figure 1, we are redirected here.

is redirected to the main page and can perform a search using the navigation panel, which is also located on each page of the platform, as it is visible in Figure 1 (A). Each internal webpage also has a breadcrumb navigation (e.g. "Search history") as shown in Figure 1 (B).

The resulting search history page is divided into two parts: a search sessions list with all logged queries, where in Figure 1 (C) the query "shaman...ingredients" is selected to check the corresponding search history; and a list of the archived web results (i.e. snippets) as displayed in Figure 1 (D). To recover the search history and snippets, a user has to choose a query from the sessions list panel. This panel includes three elements: a button to switch between the personal search history and the history generated by other members of a common group, a search bar that allows quick filter through all users' sessions and queries, and a timeline of all search sessions by descending order.

By clicking on one of the queries from the session list, a list of snippets of archived search results will be opened on the right side of the window, wherein all visited snippets are highlighted for a quick review. The visited snippet "Shaman Energy Drink" is highlighted as an example in Figure 1 (D). A filter allows to choose which snippets to visualize: only the snippets that were visited during the searching process, or to display all the snippets as they were shown in the original rank on the web results page. The clicked snippets are highlighted for easier recovering of the searching process (marked with green and has the hand icon).

## 4.2. Collaborative Work with Annotation Features

During a preliminary evaluation of our prototype, we noticed that a connection between the search history results and the original searching process was missing. In particular, while revisiting the search history results and the resources stored in the personal folders, it was difficult for the user to reconstruct the searching context and the links to the original webpages; for example to remember why a specific resource had been selected to be stored instead of others.

For this reason, we decided to introduce webpage annotations in order to provide the missing information. Among other annotation tools we choose Hypothes.is[4] and integrated their client into Learnweb ecosystem. It allows taking notes directly on online webpages or in PDF-documents, and displays an overview of all annotation activities, as it shown on Figure 2, where all the highlighted and annotated text were taking on the webpage of "Shaman Energy Drink".

All annotated parts of the webpage are shown in the right panel (Fig. 2 (B)). By clicking on one of the annotations, on the webpage will be highlighted the chosen part of the text (Fig. 2 (A)), and vice versa. More specifically, in Figure 2 (A) the annotated website where the content "SHAMAN...long-lasting.." is highlighted; and in Figure 2 (B) the annotating panel containing all comments of team members is displayed, where in our ex-

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[4]https://hypothes.is/

ample the user "tania_tol" added an annotation "Ingredients" to the previous highlighted content.

## 4.3. Learning Assumption

For the evaluation of the LogCanvas v2 search history interface, we formulate the following learning assumption, which we plan to evaluate with a specific learning scenario. We argue that **an annotation system in combination with the search history can be a useful tool for users in group projects, and can improve the teaching and learning experience.** In previous studies [32, 33], we find remarks for benefits of using annotations, such as highlighted text, comments, and tags, as a useful and easy way to achieve collective work in an online domain. Annotations on a search base can reveal the insights of group activity in collaborative work. Hence, they help teachers and students track the thought and learning process by identifying the search results over time, and at the same time document the references which were used to find the students' answers. This is profitable for students because based on the search results of their classmates, they decide to revisit a webpage or not. Documenting the search process with annotations can help students, also in motivating their choices while preparing the final course presentation. Further, it is effective for teachers as they can view the students' activity and trace their resources. Therefore, we hypothesize that joint work projects can be achieved in the Learnweb platform successfully.

# 5. Experimental Scenario

In this section we present the learning scenario we designed to test the learning assumption on the Learnweb search engine (Section 5.1), as well the user experience while completing the learning scenario in Learnweb (Section 5.2).

## 5.1. Learning Scenario

The Learnweb platform offers the ability to perform a wide variety of learning scenarios, based on the requirements and the needs of each course. Team-based, project-based, and distance learning scenarios, like the one described here, can successfully be executed.

The design of this learning scenario was based on the essential elements for TBL. Its development is influenced by a template [34] and examples for collaborative learning[5] that analytically present the structure

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[5]http://colab.eun.org/learning-scenarios

and the learning components of learning scenarios.
**Title**: Which energy drinks are poor for health?
**Target group**: High school students (15-18 years old) in Chemistry class, working in teams of 2-3 people.
**Estimated duration**: 3 hours.
**Learning environment**: Online.
**Learning outcomes**: To research and gather information from online search; to know about chemical components that commonly exist in energy drinks and their effects on health; to learn which energy drinks contain (larger) doses of unhealthy components; to enhance learning through student collaboration and new forms of assessments; to work and collaborate in a team; to organize ideas and data, and present them in front of their peers; to organize and present a final report.
**Learning scenario**: Students are asked to form groups of 2 to 3 people in the chemistry class. The teacher presents the project definition and explains the two parts of the project. In the first part, students should do research in order to identify the most common unhealthy ingredients in the energy drinks. Second, they will pick an ingredient - after discussing with the teacher, so each team picks a different one - and search about the energy drinks which include this ingredient; or if all energy drinks contain it, then pick the ones with higher concentration. The final results of each team will be reported in a brief report and presented in front of the class.
**Future perspectives**: This scenario can be further extended as a multidisciplinary project with the sports science class. Additionally, it could interest university lectures related to health, diet and sports to perform similar learning scenario as (part of) a project-based evaluation.
**Evaluation**: The students present their results in a report and prepare a presentation.

## 5.2. Execution of the Scenario in Learnweb

To perform the task, students have to search for websites containing useful information about energy drinks. In a preliminary experiment, students needed about 10 queries and visited about 20 websites to find all required answers. A similar search process is displayed in Figure 1. These answers can be highlighted/annotated in the new Learnweb platform, and all highlighted texts, annotations and websites are added to a special annotations file in the students work-space. This helps students document their work and offers them the ability to prove their process to other team members; by the timestamp and users name on each anno-

tation. The latter promotes their individual accountability and aids the accountability of each member for contributing to the team based on the TBL [31]. Furthermore, it creates a proof of work for the work carried by each member to the teacher.

Additionally, it helps other team members realise the results of their teammates tag, share, highlight or comment them, as it is displayed in Figure 2. In this way, the team can collaborate and each team member can critically comment others observations and findings. Further, it offers the ability for quick and precise feedback from the teachers, for the intermediate outcomes.

Finally, the annotations file is helpful for the final evaluation. It can help students identify quickly the important webpages and the specific parts of useful information, which they have annotated during their work on the project. Moreover, it easily links to all used resources, letting no information untraceable. Furthermore, it displays each member contribution to the team's output; by checking the annotations file; and the collaboration's between the team; by analysing the comments, tags and highlights to other team members content.

## 6. Conclusion

In this paper, we introduce LogCanvas v2 - a new and extended design of the search history visualization in our Learnweb educational platform. The new interface documents the complete search and learning process of students in a distance learning, team-based and project-based learning scenario. All visited websites are documented, relevant sections of the websites which provide answers to the student are highlighted, annotated and discussed by the students. This makes the writing of the final report much easier for the students and makes sure all references are included in this report.

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