

# An Evaluation of Thesaurus-Enhanced Visual Interfaces for Multilingual Digital Libraries

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**Abstract.** In this paper, we describe a comparative user evaluation of two multilingual thesaurus-enhanced visual user interfaces, namely T-Saurus and Searchling, developed for digital libraries. The study used 25 academic users carrying out three search tasks on both user interfaces to the UNESCO digital portal, holding 400,000 documents. It applied usability and affordance strength questionnaires, interviews, thinkalouds, and direct observation to investigate users' evaluation of the key components of both user interfaces, namely multilingual features and thesaurus and search functions. The empirical data gathered will be useful for designers of search interfaces that use thesaurus and multilingual features. Results of the study show that users were able to successfully carry out the search tasks using thesaurus-enhanced search interfaces. However, they preferred Searchling for its flexible language option, thesaurus browsing and visualization.

**Keywords:** Visual Interfaces, Multilingual Thesauri, Multilingual Digital Libraries, Information Retrieval, User Evaluation.

## 1 Introduction

Highly interactive and dynamic user interfaces for exploratory browsing and searching of digital information collections have been the focus of several recent studies. White et al. [1] note that in exploratory search, users generally combine querying and browsing strategies to foster learning and investigation. Marchionini [2] argues that semantically rich user interfaces have the potential to assist users in formulating queries, forming context for a particular search and exploring and gaining a comprehensive view of collections. Providing useful semantic assistance, particularly through visualization, within user interfaces of digital libraries requires research into the type of visualization and the associated features to support users in the exploration, searching and browsing of the collection. There have been a number of thesaurus-enhanced visual user interfaces that have been subject to evaluation. Déjà vu [3], uses the Library of Congress Thesaurus of Graphical Materials in its interface to provide a browsing facility for retrieval in a catalogue of digital media. A

user evaluation of the interface has shown that the process of browsing through the thesaurus terms in *Déjà vu* improves users' understanding of the relationship between the archive materials and the cataloguing resources. Sutcliffe et al. [4] evaluated users' interaction with a thesaurus and results browser and found that better searchers used the visualizations more effectively and spent longer on the task, whereas poorer performances were attributable to poor motivation, difficulty in assessing article relevance and poor use of system visualizations. McKay et al. [5] evaluated thesaurus-enhanced search interfaces for digital libraries and found that participants used the thesaurus less frequently when it was in a separate window, and that the multiple independent window interfaces were awkward to use. They preferred that the thesaurus act semi-automatically (that is, that it suggested search terms) rather than it automatically inserts thesaurus terms into the search, or that it forced the user to manually search the thesaurus for terms of interest. Blocks et al. [6] found that a thesaurus-enhanced search interface was successful in allowing a person with little knowledge of the interface to make use of its functionality. However, the prototype interface did not provide non-expert searchers with sufficient guidance on query structure or when to use the thesaurus within the search process. In our own previous work, we [7] evaluated a Bilingual version of Searchling and found that integrating search and browsing features was particularly useful and that the semantically enhanced visual interface was most useful at the beginning of a research project on an unfamiliar topic, because users could start by browsing through general categories for relevant terms and the Thesaurus could help them narrow or broaden their search. Other researchers [8] have found that the provision of facets on the user interface affected users' search and browsing behaviour. Users expressed interest in the ways in which facets provided starting points for browsing and searching.

In this paper we report empirical evaluation of two visual, exploratory user interfaces that take advantage of dynamic views supported by the UNESCO multilingual thesaurus in English, French and Spanish languages. The key features of the two interfaces that we have developed are a) combining searching and browsing, b) supporting dynamic exploration of the conceptual structure of a thesaurus, c) providing dynamic term relation features to give high level overviews of the terms and the collection, d) supporting multilingual search and retrieval within the UNESCO digital collections and e) utilizing a novel technique to implicitly show thesaural relationships using colour, size and distance. A comparative user evaluation of the two user interfaces was carried out to examine the multilingual and visual interface features and functionalities that support users in exploring semantic information, formulating queries and interacting with digital information. The results from the study contribute to our understanding of the factors affecting users' interaction with visual user interfaces that provide thesaural semantic support for query formulation and information exploration.

## 2 Visual User Interfaces

We developed two different visual user interfaces using the UNESCO multilingual thesaurus. They are called Searchling and T-Saurus, and their working prototypes are available at: <http://thesaurusbrowser.info>. The theoretical framework behind these



the query: main term, related terms, more specific, more general and synonymous terms. The Query space is located across the top and on the right side of the screen while the Thesaurus space is located on the left and in the centre. Users can search for a single term in the thesaurus by entering it in the query box at the top of the page and clicking the Find button. If the term exists in the thesaurus it will appear in the centre of the screen with a number in parentheses beside it, which indicates the number of documents in the collection that include the selected term. Users can also browse all the terms in the thesaurus using the panel on the left, which can be sorted either alphabetically or hierarchically by category. When a term in the list is clicked, it will appear in the centre of the screen. When a term is selected by either method it is represented by a square in the central Thesaurus space. By utilizing the checkboxes in the bottom of the right-hand panel, users can choose to view the thesaurus terms that are related, narrower (more specific), broader (more general), and preferred or non-preferred (synonyms) compared with the selected term. These associated terms are also represented in the Thesaurus space by squares and their relationship to the selected term is represented by their relative proximity and opacity. Users can also use the checkboxes in the right-hand panel to show the terms in more than one language at once and to view scope notes for selected terms. When users decide to add a term to their query, they do so by clicking on its square in the centre of the screen, at which time it is added to the Summary of Terms list, or term pool, at the top of the right-hand panel. Users can add as many terms as they like, delete them at any time, choose to keep them in only one language rather than multiple languages, and combine them using the Boolean operators below the list. When they have finished formulating their query they click Retrieve Documents to view the results (Figure 3). The red dots in the middle around the green box represent the results retrieved for the chosen term. The Green box in the middle shows the thesaurus term and its French equivalent as well as the number of documents indexed using that term.

### 3 Methodology

Twenty-five participants from the University of Alberta were recruited for this study by purposive, maximum variation and snowball sampling. Although the participant pool included students and faculty members across departments, multilingual volunteers—particularly those from the Department of Modern Languages and Cultural Studies—were specifically targeted throughout the recruitment process. The resulting participant pool was diverse, comprised of professors, graduate, and undergraduate students from a variety of disciplines, including Applied Linguistics, Latin American Studies, French Language Studies, Romance Languages and Literatures, Library and Information Studies, Humanities Computing, English and Film Studies, Education, Chemical Engineering, History, Political Science, and Music. The group contained three professors, two doctoral students, seven master's students, and thirteen undergraduates. Twenty-three of these participants were women; two were men. Of these participants, thirteen were bilingual (seven spoke French fluently; two spoke Spanish; four participants respectively spoke Mandarin, German, Latin, and Russian). One participant spoke German (first language), English, French, and Latin. Six of these participants currently conduct research in more than

one language. This study used a wide range of data gathering tools, including pre-test, post-test and usability questionnaires; interviews; audio, video and screen capture; the think aloud technique and direct observation. Data from the interviews was collected verbally, digitally, and in written form. For the first 5-10 minutes of the interview, participants responded orally to a series of questions related to their academic background, the nature of their research, and their preferred online search tools. Participants' responses were recorded in written format by the interviewer. Next, the participants were given a brief overview of the usability study before being asked to complete three identical tasks on the Searchling interface and T-Saurus interface, respectively. The interface used first was alternated between the users, and users would move between interfaces as they completed first Task 1 (on either interface), then Task 2 (on either), and so forth. During this part of the session, which generally lasted for 25-45 minutes, participants were asked to verbally analyze Searchling and T-Saurus utilizing a thinkaloud protocol as they interacted with the interfaces and completed the required tasks. Furthermore, the users' physical interactions, dialogue, and mouse movements were recorded by the Silverback multimedia program (for video, sound, and screen capture), while the interviewer answered questions, provided hints if needed, and made written notes on the participants' engagement with, and comments on, the prototypes

## 4 Results

### 4.1 Tasks

All users chose a combination of browsing and searching strategies to carry out the three search tasks. Around half of the users chose to carry out a search first for their three tasks. The other half decided to use browsing strategies to find the term and its associated terms. However, browsing accounted for a significant part of their interaction, particularly for Task 1 in which users were asked to find the term 'Democracy' and one of its related terms. This task required that they interact with the thesaurus to browse and find a related term from among a list of terms that were hierarchically or semantically related to the term Democracy. In Searchling they typically decided to use the high level facets and the terms under each facet. Within T-Saurus, users browsed the alphabetical list on the left-hand side of the screen to find the term. A number of users liked Searchling for its results display as it showed the retrieved documents within the same interface without losing the context of thesaurus or search. In more than 10 searches, users found that the red-dot visualization representing the retrieved documents in T-Saurus was vague and at times difficult to interact with. In Task 2 users were asked to interact with multilingual and filtering (Boolean operators) features of both interfaces to combine two terms and retrieve documents in Spanish. Due to the multi-term nature of this Task, almost half of the users conducted Boolean searches first and browsing next. The Boolean search features of both Searchling and T-Saurus were found very useful by participants. Several commented that they would prefer an advanced search option built into the query formulation stage of the search process, where they could use a combination of Boolean operators. The auto-completion feature within the T-

Saurus search box was found particularly useful and interesting. A majority of users expressed positive comments about the search term pool feature available in Searchling. Also, when users browse and choose a term in the thesaurus, the selected term(s) gets automatically added to the search term pool area, making it particularly easy for the searcher to create a more sophisticated query statement. All users found the language option within Searchling flexible, intuitive and easy to use. The results from the third task were mixed. This was, in part, due to the wide variety of search terms that users employed to carry out searches based on their own specific research interests and needs. Some users experienced frustration as they were not able to find terms that matched their query terms. Others found specific features of each interface appealing or useful. In Task 3 users were asked to freely search or browse using their own information and research needs. Most comments made by users for Task 3 focused on various interface features, such as (in T-Saurus) the breadcrumb feature and visual grouping of thesaurus terms, and (in Searchling) the sort of results display, search term pool, and linear organization.

#### **4.2 Multilingual Features in Searchling and T-Saurus**

As was discussed before, both interfaces allow users to choose thesaurus terms for searching in three different languages, namely English, French and Spanish. Participants liked the language features in both user interfaces for their easy access and contextual display of thesaurus terms in different languages. The majority of study participants found the Searchling interface user-friendly, intuitive, and particularly flexible across the languages. Around 88% of users agreed or strongly agreed that the Searchling interface would help them locate relevant results in Spanish, French and/or English, whereas 72% of users agreed or strongly agreed that the T-Saurus interface provided useful language options. The main difference between the language feature in Searchling and T-Saurus is that the three languages in Searchling are all clickable and upon clicking on each thesaurus term, that term becomes prominent in bold and the equivalent terms in the other two languages will be shown. In T-Saurus the feature is different in that clicking on a thesaurus term will show the term in English with the other two equivalents. One user noted the generative attributes of the interface, stating that she would use Searchling “to find relevant information in English and French for a particular topic that she may have otherwise not thought of.” Another user commented that showing English related terms when carrying out a French search would be very useful in Searchling. Above 60% of the users thought that using a thesaurus-enhanced search interface would help them formulate research questions.

#### **4.3 Thesaurus and Search Functions**

One of the research questions in this study was to examine how users evaluate the thesaurus and search functions of the two interfaces. We were interested to know what kind of thesaurus presentation and visualization would be easy to understand and easy to use by academic users. The Searchling user interface provides a design similar to a faceted search interface. It uses the high level facets of the UNESCO thesaurus along with a list of terms for each facet. The T-Saurus interface provides a more visualized and interactive interface where users have to interact with the interface to choose thesaural

term relationships, such as more general, more specific or related terms. Both Searchling and T-Saurus allow users to browse thesaurus terms both hierarchically and alphabetically. The default option for Searchling is the faceted view of the thesaurus, whereas in T-Saurus the alphabetical list is default. For assessing the affordance strength of the two user interfaces we asked the users to give the thesaurus and search functions of Searchling and T-Saurus a score ranging from Very Difficult to Very Easy, or Not at all to Very Much, depending on the question. The search and thesaurus functions in Searchling were rated higher (76% and 68% respectively) than T-Saurus (40% and 40% respectively), indicating that Searchling's search and thesaurus functions are significantly easier to use than those functions in T-Saurus. Also, 16% of users found that T-Saurus was more difficult to use than Searchling.

As part of the assessment of affordance strength, we asked users two additional questions. The first question was if the thesaurus-based grouping of results provided by these interfaces was helpful in developing searches. Around 24% of users mentioned "very much" while 52% said "somewhat". The second question asked them whether they would be motivated to use Searchling or T-Saurus as an interface to their more frequently used databases. It was found that around 72% would be Very much or Somewhat motivated to use Searchling, while only 52% would be motivated to use T-Saurus. A final question asked users which interface they generally preferred, Searchling or T-Saurus. Around 56% preferred Searchling, while 40% thought T-Saurus was a better user interface. This final questions confirms the findings related to all the interface features discussed before, namely multilingual and thesaurus and search functions.

## 5 Conclusion

This comparative usability study has yielded promising implications for the multilingual thesaurus-enhanced user interfaces to support users in their information seeking process. The visualization in both interfaces was found to be comprehensible to users. A common observation for both interfaces was that users found the thesaurus functions useful for broadening and narrowing down the scope of their research activities. In general, the Searchling interface was found to be more favorable and easier to use in terms of multilingual features, thesaurus and search functions and users' motivation to use such an interface for research purposes. Though T-Saurus, was preferred by fewer users than Searchling, the most promising finding for T-Saurus was that it has the potential not only to support browsing, searching, and query formulation, but also to transform these processes. It was found that linear thinkers preferred Searchling, whereas visual learners liked T-Saurus. Searchling is a linear, sequential and visual interface that uses faceted structure as its default interface and the thesaurus terms such as more general, more specific and related terms would be shown automatically as soon as a term was selected by the user. T-Saurus, on the other hand, provides users with a more interactive and dynamic visualization interface where users need to interact with and choose individual thesaurus term relationships to be shown. In general, this study found that faceted presentation of thesauri was more favourable than visual and graphical. The results from this study indicate that for exploring and using thesaurus terms in a search user interface, most users prefer related, more specific and more general terms to be shown along with the selected term without additional effort. In other words, upon searching for a term,

users should be provided all the related terms automatically for detailed view and selection. It would be interesting to observe how users with different cognitive, perceptual and learning styles may have different preferences when they interact with visual user interfaces. Further research may use a verbalizer/visualize cognitive inventory [10] to formally study how each learning style will affect users' interaction with visual user interfaces enhanced with such semantic tools as thesauri. Many users noted positive implications of the thesauri functions in both Searchling and T-Saurus, from undergraduates new to a topic to multilingual experts well versed in the terminology of their field of research.

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