

# ExplorationMap: Supporting Collaborative Exploratory Information Seeking

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## ABSTRACT

Exploratory information seeking in a knowledge domain, especially in an interdisciplinary area, with the purpose of learning and getting a sense of the domain is a challenge that new researchers are constantly facing. To address this challenge, we suggest a new visualization-based approach for collaborative exploratory information seeking. First, we introduce ExplorationMap, which is a node-link graph visualization of the pathways explored by the user. Then, we discuss how the ExplorationMap can establish the ground for collaboration between researchers, while exploring a knowledge domain. We believe that ExplorationMap can facilitate sensemaking processes as well as learning through exploratory search, all of which we will verify in the next steps.

## Author Keywords

Exploratory search, collaborative information seeking, exploration, sensemaking.

## ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

## INTRODUCTION

Exploratory information seeking includes activities such as information look-up, learning, and investigation that can overlap in time [8]. Different forms of collaboration have been proved to facilitate and make each of these activities more effective and more efficient by employing varieties of expertise, knowledge, and perspectives. More knowledgeable information seekers can achieve meaningful learning [2] easier than less knowledgeable ones in an exploratory search process because of the more developed schemas, which enable them to find the associations

between ‘what exists’ in their schemas and ‘what they find’ more efficiently, whereas less knowledgeable searchers are constantly suffering from lacking sufficient domain knowledge in their explorations. This fact justifies this famous frequent demand of a new researcher in a field to the expert researchers: “tell me what I don’t know I need to know”. The suggested approach aims to support and facilitate such collaboration between these two groups, which can be very beneficial for novice researchers. Also, for motivating the experts to participate in such a collaborative search process, we should consider reducing the participation cost, which is a determining factor.

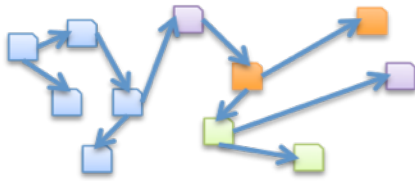
This collaborative search can also be considered as a social search: “a range of social interactions facilitating information seeking and sensemaking tasks” [5]. The social interactions before, during, and after the search episodes have been investigated by Evan and Chi; their results showed that social interactions before the search will give the searchers some clarifications and guidelines on the tasks, advice, suggestions, keywords, URLs, and etc [5]. All of these artifacts, results of the social interactions before the search episode, will also be useful *during* the exploratory search, which is inherently a long-term and iterative process. Therefore, given the fact that the searcher’s interests and needs are evolving and being shaped during an exploratory search process, we aim to support all the *before* the search social interactions during the exploratory search.

In this paper, we describe the design of a system for supporting collaborative exploratory search. The means of the collaboration is ExplorationMap, a visualization of the information seeker’s path. The collaboration can be between a domain A expert/a domain B expert or a domain A expert/a domain A novice based on the roles suggested by [7]. Experts can bridge the gaps that novices are constantly facing, between what they know and what they seek for. An information seeker can rely on information scent provided by various cues on his ExplorationMap that have been suggested by the experts. These cues can be anything such as a new relationship between two concepts, a tag, a new journal, and etc. This kind of collaboration is of crucial importance in interdisciplinary research areas, in which the searchers should have a broad knowledge of the domain not to miss the relationships in their exploratory

search. Considering the classification of computer-supported collaboration in information seeking suggested by [7], this work falls into the category of explicit and both synchronous and asynchronous collaborations.

### **EXPLORATIONMAP: BUILDING FOUNDATIONS FOR COLLABORATION**

Keeping the history of explorations is a critical consideration in designing exploratory search support systems, as usually information seekers need to go back and forth between their findings to get a sense of the domain under exploration. We suggest recording the pathways, which have been traversed by the user, in ExplorationMap in the form of a node-link graph, in which a node is a representative of a visited resource such as a web page or a paper and links show the user's path. If visiting node 'A' introduces node 'B' to the user and the user continues his journey from 'A' to 'B', there will be a link from 'A' to 'B' in the ExplorationMap. For example, a link can be a representative of a citation, or a new search session with additional keywords that have been found in the source node. Visiting a page, whether it's a new article or a webpage, can introduce new references, keywords, authors, journals, and conferences, all of which can shape the next steps in the exploration and be the causes of visiting the next series of pages. In this paper, we will consider the following simplified preliminary design (Figure 1) for the ExplorationMap to focus on the idea of collaborative information seeking.



**Figure 1: An example of node-link exploration map. Each node represents the visited resource and link represent the user's path between resources**

The ExplorationMap can help the searcher to explore and make sense of the domain more effectively and efficiently for at least two reasons. First, it will facilitate sensemaking [6] of the domain under exploration by providing overview of the traversed pathways and unveiling the semantic connections between the explored concepts through externalizing the internal connections in the mind. Secondly, we believe that sharing the ExplorationMap will be much more effective in collaborative search than sharing the information need, which is inherently unclear in an exploratory search. The ExplorationMap can provide more contexts around the unclear information need that can help collaborators to gain a better understanding of the user's information need and to establish the common ground for achieving more effective collaboration, however, in the systems supporting co-located collaborative search such as [1], common ground can be achieved much easier through face-to-face communications.

### **Design Goal & System Features**

Our primary goal in designing ExplorationMap is to facilitate and support meaningful learning in exploratory search. We plan to achieve this goal in two complementary ways; first, through designing an intuitive visualization of the explored path and secondly, through sharing this visualization with the relevant people to the explored domain and making the exploratory search more effective through collaboration. In order to support learning in collaborative exploratory search, the collaboration needs to be developed in the background not to interfere with the primary task and to keep the information seeker in the flow [4].

The following features have been considered in designing the ExplorationMap:

*ExplorationMap is automatically generated while the user is exploring*

In order to let the user become immersed in his exploration, the ExplorationMap is automatically generated without requiring the involvement of the user while providing awareness of the path under exploration.

*User should be able to reflect on his experiences and findings during the path he has taken*

This reflection can be as simple as marking the explored nodes as relevant or irrelevant, or more costly actions such as annotating the nodes with some navigational advices to enable the system to suggest their findings to other users with similar interests and goals. As users move forward in their explorations, they learn and make sense of the connections between resources; this feature enables the users to reflect on their experience of going through a specific pathway by providing additional information scent (cue) on their ExplorationMaps for their future explorations or to help other users in that domain through sharing and enabling the integration of ExplorationMaps.

*Visualizing the evolution of user's interest during the search*

It is important for the user to be aware of the evolution happening to his interests during the search. This can be done using a dynamic tag cloud to visualize the most frequent keywords in the explored resources over time that reflect the current focus and interest of the user.

*Providing preview of the nodes on the path*

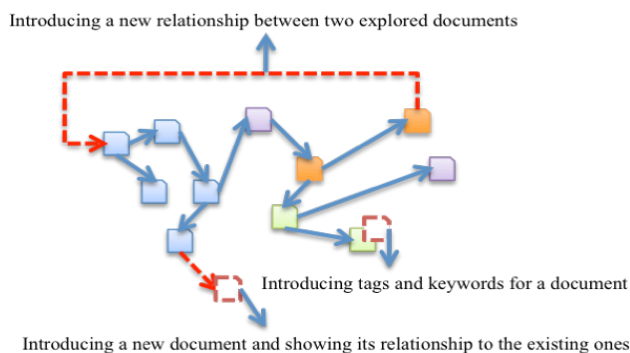
Preview of the nodes shows the least information for recognizing the node without going back to it. This will enable the users to navigate in their ExplorationMap more easily for refreshing the memory or annotating without having to re-explore some of the resources.

### **RECOMMENDATIONS ON THE EXPLORATION MAP**

Analyzing the user's pathways and extracting the authors' names in the already traversed nodes will generate a sorted list of authors, whose publications have been visited. The

editable ExplorationMap of the searcher will be shared with the key authors in the list, who can provide some navigational advices for the novice by adding related keywords or tags, unveiling the relationships between some of the existing concepts in the map, and introducing potentially interesting unexplored areas for the user. Similar suggestion-based approaches for encouraging the contribution of experts have been applied on some of the online communities such as Wikipedia [3].

Because the system tries to involve experts for providing these information scents, we can expect them to be of high quality [10]. The high quality of recommendations is one of the advantages of such systems over social bookmarking applications. Although social tagging systems can provide both intentional and inferred navigational advices, most of the social tagging systems suffer from the contributors' quality [9].



**Figure 2: Collaborators' recommendations are shown in the ExplorationMap by the red dotted lines. The recommendations can have different forms including introduction of a new relationship, new resource, tags and keywords. The color of the nodes shows the associated domain with a resource. For example, orange nodes are the visited articles from domain A, blue ones from domain B, and so on.**

Once the domain expert augments the user's ExplorationMap, the user can see the recommendations on his ExplorationMap (Figure 2). The experts' recommendations will be associated with the search behavior for future use in order to avoid sending repetitive requests to experts.

## CONCLUSION

Exploratory information seeking can be considered as an effective learning activity that the lack of support tools can transform it into a frustrating activity. Information seeking in an interdisciplinary area is an example of such activity that needs the appropriate support to be effective. For

achieving our goal of supporting learning in exploratory search, we introduced the ExplorationMap, which is a node-link graph that shows the pathways explored by the user. We believe this ExplorationMap will help us achieve our goal in two ways: first, by facilitating the sensemaking processes with having the externalized overview of the process and secondly, by providing the foundations for collaborative search with two different purposes: taking advantage of experts' knowledge in the domain under explorations and accelerating other users' search with similar information needs.

## ACKNOWLEDGMENTS

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