User Interface for Knowledge Sharing Using Knowledge Gardening Metaphor

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Abstract. Knowledge sharing is presumed to be better facilitated through knowledge gardening metaphor. Nonetheless, there is a research gap in the metaphor application, where there is yet a formal elicitation undertaken towards it. This paper intends to answer three questions: How does knowledge gardening metaphor supports knowledge sharing within a user interface? What properties should the overall user interface have to support user-oriented environment? How can the knowledge gardening metaphor be elicited? Henceforth, a description on the user interface design incorporating knowledge gardening metaphor is discussed. Steps undertaken in a metaphor elicitation are also provided.

Keywords: Knowledge Sharing, User Interface Design, Metaphor, Metaphor Elicitation.

1 Introduction

To enable knowledge sharing activities, proper infrastructures and connectivity must be provided in order to empower and sustain a knowledge culture and its resulting initiatives. Related human behaviours must also be considered as prior studies have consistently find that knowledge sharing is positively related to having status similarity (Cohen and Zhou, 1991) and a history of prior relationship (Krackhardt, 1992). However, there is yet a system that provides all the features that good ‘gardeners' of academic knowledge ecologies would want to have (Pór and Molloy, 2000).

Knowledge gardening is defined by having in place a specific activity to support, a database, allowing metadata vocabulary definition and search on shared items as well as monitor changes made. This approach is applicable to any digital artifacts created and found in the course of daily work (Udell, 2004). This has motivated our work of testing the applicability of the knowledge gardening metaphor in an academic digital sharing environment.

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2 Conception of Knowledge Gardening Metaphor in an Academic Web Space

The conception of knowledge gardening metaphor in our study was driven by two research questions; *1. How does knowledge gardening metaphor supports knowledge sharing within a user interface?* and 2. *What properties should the overall user interface have to support user-oriented environment?*. We developed a user interface prototype to support knowledge sharing activities by identifying five knowledge gardening processes, i.e. knowledge seeding, knowledge landscaping, knowledge transplanting, knowledge harvesting and knowledge weeding.

2.1 Knowledge Seeding

Knowledge seeding is the introduction of article(s) into a knowledge repository with the intention of sharing and distributing its benefits. It can take place in two ways; users contributing articles of their possession or submit articles found through external search.

Seeding Own Articles
Users are provided with a form-fill interface where one is required to upload the article source file and provide mandatory information like article's title, author names, abstract and a list of keywords. These fields are made mandatory as they can be unique in context and can easily help with distinguishing one article to another. These mandatory details when submitted would allow users to be more well-informed about the article effortlessly. The information can also infuse users for further reading and help users make quick decisions on retrieval decisions.

Keyword listing plays an imperative factor for the success of knowledge gardening (Udell, 2005) as it helps in the clustering of relevant papers during article search.

Seeding External Articles
It is proposed that users are not confined to articles available within the system's repository alone. Users should be able to seek articles in other search engine (our study used Google search engine) by attaching it within the system. Hence, users would be able to contribute articles found externally which indirectly encourage them to not selfishly hold good materials to themselves. It may seem that users are not able to retrieve external materials for personal keeping and that they are forced to share when using this system. However, some duress is needed in order to ensure continuous sharing.

2.2 Knowledge Landscaping

Knowledge landscaping is about adding and editing supplementary information regarding the article in order to attract a wider audience. It comes in the form of article rating, recommendation and commentaries as well as the editing of supplementary information.

Rating, Recommendation and Commentary Features
Many academic websites provide rating capabilities but most do not provide description on what a score truly represents. This creates ambiguity as one user's perception of a score differs from another user's. This in turn generates a false impression on the overall rating the article has received. In our study, we have explicitly describe what a score represents, allowing users to choose a specific value that best represents their opinions.

The recommendation feature acts as a venue for advice in influencing why and to whom the article would be worthy and desirable. Commentaries feature on the other hand consist of statements that express a personal opinion when interpreting a particular article. Recommendation and commentary features are provided as sharing and debating knowledge is far more powerful than simply uploading new article in a database. It is a way to test ideas, collect evidence, and mediate discussions electronically (Brown, 1999).

Reservations on the reliability of recommendations and comments are expected. In that matter, Neus (2001) mentioned that users will eventually know whose recommendations and comments they should take heed. They will be able to identify who has the right mixture of being knowledgeable and accessible in the continuing dialogue in due time.

Editing Features
Knowledge landscaping also involves the editing of supplementary information through the edit function. This feature allows users to make constant revision to improve the accuracy and relevance of the information in regards to the article.

2.3 Knowledge Transplanting

Knowledge transplanting is defined as reallocating an article from one location to a more fitting location. It is done in order for the article to better-reach targeted readers/retrievers. This metaphor simply involves users reallocating an article into another subject area.

2.4 Knowledge Harvesting

Knowledge harvesting is an activity that (i) captures the expertise of article authors and knowledge contributors (through recommendations and commentaries), (ii) prevent knowledge loss and (iii) ensure knowledge continuity. In the context of our study, users can harvest knowledge via knowledge repository or via external search engine.

Knowledge Harvesting via Knowledge Repository
Users can seek articles through keyword search, article title search or author search. Users are also able to refine their search query by selecting publication year, subject areas and paper types (i.e.: seminal, current or archive papers). These options are convenient for users who have different information seeking style (Ingwersen, 1992).

Users can choose article of choice from the results list where each selection will provide users with the article's general information, its ratings, recommendations and

commentaries. This allow users to weigh the contribution potential of the article in regards to their academic activities, hence supporting a better search and retrieval process.

Users are able to retrieve articles by (i) adding to book collection, (ii) berrypick article or (iii) save article via adobe interface. The bookcart feature plays an important role during the retrieval process. It contains four folders which stores short cut links for each retrievals depending on retrieval type, as seen in Table 1. It is used to track article retrievals as well as track articles' 'landscapes' easily.

Table 1. Bookcart's Folder Description

Folders	Description
Book Collection	Store user's favourite articles from the knowledge repository.
KCG Berrypick	– Temporarily store articles retrieved from knowledge repository within a 3 day time frame. – Useful for users who wants to defer reading. – Suitable for information foragers who constantly modify their search strategies.
Google Berrypick	Works the same as KGC Berrypicks, but concerns with materials found via Google search engine.
KGC Retrievals	Store links of articles retrieved from the knowledge repository and saved in user's own hard disc.

For each article link in the bookcart, users can be briefly reminded of the article in terms of authors, keywords and one third of the abstract by hovering on the article's title. Example can be seen in Figure 1.

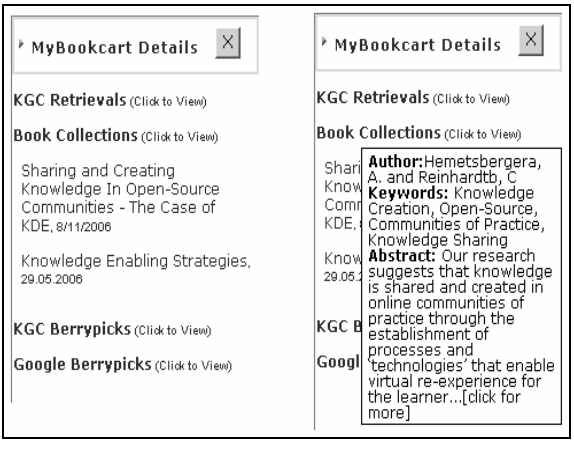

Fig. 1. Brief Reminder Provided By Hovering on the Article's Title

Knowledge Harvesting via External Channel

By providing an external channel, users are able to harvest more materials. Even though search and retrieval is done within Google, knowledge harvesting can still be

experienced as the process involved is similar to knowledge harvesting via knowledge repository. However, users are not able to directly retrieve the articles derived from Google search. They can only berrypick them.

2.5 Knowledge Weeding

Knowledge weeding is defined as the suppression of untrustworthy and irrelevant articles. This is done to ensure better and reliable knowledge delegation and sharing. In the context of our study, it involves users duly request knowledge removal. However, it is the Super Gardener who will make the final decision as they are in the better position of evaluating the rationale of the request and relevance of the article to academic trends. The privilege for material deletion is not provided to all as material deletion affects site content and navigational structures. It also greatly affects article retrievers who constantly track the article for 'landscape' updates.

2.6 Human Behaviour Support

The conception of knowledge gardening metaphor has also incorporated human behaviours. This section shall briefly describe how human behaviours are incorporated through the user interface design.

Feedback through Recommendation and Commentaries
In a knowledge sharing organization, appropriate feedback is very critical. Respond of others through recommendation and commentaries contributes to self-worth development and better sense of self-competence (Covington and Beery, 1976). Social ties are also created by responding to each others' posting (Wasko and Faraj, 2005).

Seminal, Current and Archived Paper Categorization
Paper categorization acts as information scent. Users require proximal cues to identify desirable and relevant information sources and to navigate towards them (Pirolli, 2001). Allowing users to recognize a pattern of categorization would allow him to go "beyond the information given" by using probability and prediction (Bruner, 1973). This help increase the amount of relevant information acquired by user. If a user can attend to more information per unit time, then the user's information processing capacity is increased, amplifying cognitive capital.

Article Logging
Users are provided with a sense of awareness by informing who is around and what actions are done by them (Roseman, 1996) through article logs. Article logging also supports the need for chronological awareness (Chen and Gaines, 1996), where users need to be aware when a resource exists and changed. Modification must be tracked so that contributors of change can be credited and allow selective reversing of changes.

3 Experimental Set Up

The experimental set up was driven by the following research question, *How can knowledge gardening metaphor be elicited?*.

3.1 Participants

Three lecturers from the Human Computer Interaction Special Interest Group of the Universiti Teknologi Mara were selected as participants. As they are regarded as usability specialist, 2 to 5 participants would be sufficient to conduct inspection evaluation (Koyani et. al, 2006).

3.2 Usability Test

The usability test mainly involves users performing task scenarios via a prototype which are closely related to the knowledge gardening metaphor. Question asking protocol was also carried out to get the participants to react to the interface, to understand their mental model of the system and the tasks, and to identify where they have usage trouble.

After completing the task scenarios, users were given post-task questionnaire which was designed base on Nielsen's (2003) definition of usability. Questions were grouped into four constructs; learnability, efficiency, memorability, and satisfaction. Questions acquiring participants' perceived social and intellectual capital gained were also included.

3.3 Metaphor Test

Metaphor test involves assessing users' mental models on the tested concept as well as assess the metaphor structure. This comes in the form of card sorting exercise and post-task questionnaire respectively.

Before card sorting exercise, users are briefed on the knowledge gardening metaphor. Participants are then asked to allocate 33 index cards in one of the knowledge gardening metaphor categories or under the unknown category (if they do not know to which category the card belongs to). In our study, the index cards contained only screen captures, but no description to avoid influencing participant's judgment during card sorting.

In order to resolve ambiguity, we classified knowledge gardening metaphor into 5 categories; knowledge seeding, knowledge transplanting, knowledge landscaping, knowledge harvesting and knowledge weeding. The categories are displayed with posters, labeled with specific gardening names and description. The allocation of the cards under each category reflects their understanding of the metaphor.

Card Scoring
In this research, the scores are given based on the following descriptions, seen in Table 2.

Table 2. Card Scoring

Characteristics	Score
User allocate required object correctly, where i(th) object ≡ j(th) object	1
User did not allocate required object, where i(th) object = Ø, j(th) object = 1	0
User allocate incorrect object, where j(th) object = Ø, i(th) object = 1	-1

The i(th) object represents user's allocation while j(th) object represents the required object within a category set. On a spreadsheet, card numbers were listed sequentially along the x (horizontal) and y (vertical) axes. The scores as seen in Table 2 were written into the intersection accordingly. In order to assess how well participants understood the metaphor, a simple statistical method of calculating the percentage of correct allocation was done.

Post-Task Questionnaire
Four structure constructs were used to gather participants' perception on the metaphor structure. They are amount, applicability, representation and suitability.

4 Findings

We have found that the conceptualization of an academic web space user interface using knowledge gardening metaphor is able to support knowledge sharing activities. This was evident from participants being able to perform all required task scenarios and associating them to the metaphor without much difficulty. This was made possible through the categorization of knowledge gardening metaphor into knowledge seeding, knowledge landscaping, knowledge transplanting, knowledge harvesting and knowledge weeding. The categorization helps identify tools and other functionalities required during user interface design. This in turns allow better knowledge sharing facilitation within an academic web space.

Other than identifying tasks requirements and conditions, the knowledge gardening metaphor has also help identify the need to support human behaviours. The analysis on the usability test conducted showed that this was well accorded for through out the user interface design. Four usability constructs used for assessment showed that the user interface is efficient to use as the information is organized intuitively and appropriately placed. Good navigation layout and simplified task steps have helped participants performed required tasks efficiently as well. Memorability factor was supported mainly through the bookcart feature as it enables users to jog their memory of what have been retrieved and where it is located. It is also found that the user interface provides relevant knowledge sharing functions, is pleasant and the content well organized. This makes it easy and intuitive to perform tasks, enabling participants to enjoy using the interface, increasing the satisfaction factor. However, more can be done to improve the learnability aspect. Novices who have little experience in using knowledge sharing system may experience some difficulties.

From the findings gathered it is suggested that the user interface design is improved by providing:

a. Buttons and links that is easily understood on the first time basis,
b. More logical and consistent content layout, and
c. More colour schemes in differentiating functions and sub-functions.

The capital findings in terms of social and intellectual also adds to the evidence that human behaviours are well supported. Both social and intellectual capital plays very important role in knowledge sharing. This is accorded for by having the system taking note on users' every form of contribution, paper categorization, as well as providing ratings, commentaries and recommendation features.

Finally, the experiments carried out have shown that metaphor elicitation can be carried out through a series of card sorting exercise and responding to post-task questionnaire. Through the card sorting exercise, it is gathered that the metaphor was well understood, with harvesting being the least and weeding the most understood. As card sorting reflects users' mental model, it was found that each metaphor component is relatively easy to understand. In terms of metaphor structure however, there is still a need for improvement. The amount of metaphor structure is found to be poor. This was reflected during card sorting exercise where participants had difficulties in allocating some of the index cards correctly. Hence, improvements need to be done to increase the 'feel' of the metaphor. Nonetheless, it was also found that knowledge gardening metaphor would be useful and applicable in various areas. This is so as the underlying concept was elementary in the sharing and maintaining of knowledge. Moreover, the underlying concept of knowledge gardening metaphor was also found to be suitable for knowledge sharing. Finally, the metaphor was well represented in the user interface. It plays on intuitiveness by relating closely to the common gardening activities.

5 Conclusion

This section concludes the paper by describing the specific outcomes of the study and importance. This research has formally studied the capacity that knowledge gardening metaphor embodies to support knowledge sharing within an academic web space. The outcome of this research presents a testimony that knowledge gardening metaphor is adeptly capable to support collective knowledge sharing within an academic institution. The capability of the metaphor to support social and intellectual human behaviours has also shown that the metaphor is not just about being task oriented. It is capable to provide better knowledge sharing experience, hence encouraging future use.

This study is significant as currently the application of knowledge gardening metaphor is lacking a systematic approach in assessing its structure applicability. Hence, this paper has underlined steps that can be taken to elicit a metaphor once it is fully conceived in a user interface design. It has proven that responding to post-task questionnaire after card sorting exercise provides a more comprehensive and validated insight to user's mental model on the tested concept. This in its own provides empirical evidence that metaphor elicitation needs to be tested in terms of user's understanding, structure applicability and usability. Researchers, designers or

developers of knowledge gardening metaphor should apply the approach taken to construct better and more effective knowledge sharing system that meet users needs.

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