Evaluation of a Visualisation Design for Knowledge Sharing and Information Discovery

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Luís Manuel Borges Gouveia
lmbg@ufp.pt

Feliz Ribeiro Gouveia
fribeiro@ufp.pt

Centro de Recursos Multimediáticos
Universidade Fernando Pessoa
Porto - Portugal

Presentation abstract

• present a tool using a 3D interactive visualisation system that allows knowledge sharing and information discovery

• propose a visualisation design using direct manipulation techniques to convey information about a structure for knowledge sharing

• the structure describes a knowledge theme described as a set of concepts providing a particular context description about the knowledge being shared

• the application was tested using the set of concepts to direct searches in the World Wide Web
Presentation abstract

- preliminary evaluation results are reported: showing that the system tends to better support people with some *knowledge expertise* about the knowledge being shared even if they have little *Web expertise*
  - this show potential for the visualisation design as an interface for both knowledge sharing and information discovery
  - for people that have already some theme *knowledge expertise*, but suffer from information overload or lack of knowledge about the structure of large information spaces such the Web

Way One: virtual reality
Way two: ubiquitous computing

“Two way” integration: visualisation

- **definition**: use of images and animations to convey information
- **goal**: effectively convey information to the user
  - transforms the abstract and symbolic into the geometric
  - harnesses the human perception system (visual?)
Visualisation (why?)

• 3D visualisation can offer a more convenient and natural way for people to interact with information spaces (as distinct from environments that are naturally 3D) [Tufte, 1990] and [Benedikt, 1992].
• to date there is not much evidence to support it, other than in cases where the information has a natural spatial component [Hubbold et al., 1995]
• many problems as user sense of position that can be lost if the layout changes [Ingram and Benford, 1995]

Visualisation (task approach)

• an application for testing the visualisation design:
  – information discovery: support user efforts to find relevant information within a given knowledge domain [Li-Jen and Gaines, 1998]
  – setting up a context, a query generation tool and an Information Visualisation [Card et al., 1999]; providing context and information about a particular data source for analysis and comparison.
• based on a given context shared as a 3D interactive visualisation, users can be assisted to retrieve information and analyse it information discovery [Baeza-Yates and Ribeiro-Neto, 1990]
The evaluated prototype

The prototype implements:

- a concept space as a 3D interactive visualisation;
- a visualisation design composed by two distinct visualisations: a concept space, representing the structure, and a criteria space that allows spatial positioning by specifying up to three criteria;
- data source integration by using an Information Visualisation within the criteria space visualisation;
- displaying of results using a search engine (the AltaVista Search Personal eXtension 97).

Goals

- prototype (3D interactive visualisation) goals:
  - convey information about a structure for knowledge sharing
  - test how this could support knowledge sharing by proposing a particular system to give support to users in information discovery
  - help users to build their own queries by using a textual search engine based on information from the structure for knowledge sharing
  - allows the visualisation of data source information within the visualisation design and displaying of results using an HTML browser
Goals and rationale

- tool advantages are greater when data sources do not have an underlying structure and a query returns a vast amount of results as is the case of the Web
  - information overload occurs...
- tool based on a shared interactive representation of a knowledge theme that can be used to construct queries and compare a data source with the domain representation
  - allow user individual application of shared context
- a basic support for collaboration is implemented within the system to share the knowledge domain representation and to enhance it

Concept definition and structure

**Concept**

*(example)* ENTERPRISE

$K_i - keywords$

*Rating [0, 1]*

amount of relation with the concept

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A partial concept space structure example

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Concept space

Concepts are represented by spheres
Sphere colour gives the concept type
Sphere size gives the concept description rate
Semantic Distance is represented by lines between spheres
Spatial position is used with no other meaning than to place concepts for increase readability
Concept space visualisation
Criteria space

Keyword list (criteria)

Criteria space Visualisation
Criteria space quadrants analysis

Criteria sequences: for three dimensions, eight possible sequences

Mapping concepts in criteria space quadrants
Information Visualisation in criteria space

Just first quadrant concepts have data source equivalents

Associated concept in the data source
Accessing results

Evaluation

• selected 11 undergraduate students from UFP
  – the subjects were volunteers and no payment has been made for their participation
  – the knowledge domain was Information Management
  – the subjects were asked to use the prototype in six activities covering the following issues:
    • use the concept space;
    • use the criteria space;
    • analyse one concept relations;
    • create a criteria space;
    • perform a concept search;
    • perform a keyword search;
Evaluation script

• one-hour and half composed of the following activities:
  • a pre-experiment questionnaire (5 minutes);
  • a general overview of the tool functionality (10 minutes demo) giving by the evaluator;
  • a lab training period (10 minutes);
  • break (5 minutes);
  • continuous session for performing the proposed six activities (50 minutes);
  • a post-experiment questionnaire (10 minutes)

Evaluation factors

• asking each student:
  • what they have learned (as measured by a multiple-choice questionnaire);
  • how they think the system helped them (like/dislike rating);
  • what is their opinion about using the system (like/dislike rating);
• taking the time to complete of the six activities;
• performance is examined taking into account students own rating as low or high in:
  • Web expertise
  • Knowledge domain expertise (Information Management)
Data analysis

- about the learn variable (test questionnaire):
  - web expertise has significance at a 5% level;
  - knowledge expertise has significance at a 1% level;
  - both web and knowledge expertise are significant but with subject being more significance. No important interaction between both variables has been reported.

Data analysis

- about the relation between web and knowledge experience:
  - in the presence of knowledge expertise, the web expertise is no more significant at a 5% level;
  - in the presence of web expertise, the subject expertise is approximately significant at a 5% level.

- about the help variable (low/high help for the users):
  - there is no evidence of meaningful effects with web and knowledge expertise;
  - with both web and knowledge expertise together there is also no effects.
Data analysis

• about the opinion variable (low/high help for users):
  • web expertise is not significant;
  • knowledge expertise is approximately significant at a 10% level;
  • with both web and knowledge expertise there are no effects.
• about the time to complete variable (taking into account subjects that complete all tasks):
  • web expertise is significant at 1% level;
  • knowledge expertise is significant at 5% level;
  • both web and knowledge expertise do not have any relation

Concluding remarks

• people learn more when they had already some expertise in the knowledge area
• the importance of using the web before was moderate although not so important as the knowledge expertise to explain questionnaire results (learn)
• the users feeling about how the system helps them has not any impact from their web or knowledge expertise
• when considering user opinion about the system, knowledge expertise seems to have some importance, regardless of the web expertise
Concluding remarks

- operation of the system seems to be influenced by the users web expertise in a very important way
  - knowledge expertise also assists users in system operation
- overall, the system tends to better support people with some knowledge expertise and little web expertise
  - seems to show some potential as an interface to access information for people that have already some knowledge expertise - more evaluation needed!

Concluding remarks

- use of visualisation techniques can improve the interface by supporting familiar cues to user perception and thus convey information for knowledge sharing
- people were able to use the visualisation design