Uncovering the Main Elements of Geo-Web Usability

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SUMMARY

Usability has become an important issue for improving web design. However, specific studies on determining elements for geo-web usability are almost non-existent. Therefore, this paper describes our first approach to uncover the main elements of geo-web-usability. Three main elements have been identified as critical for usability; they are web content, human-computer interaction, and user satisfaction. A study was carried out on the Portal for cultural heritage in the Netherlands to measure them. For this study, four sections of the geo-web interface were used for testing purposes: map display, table of content, basic functionalities and query.

KEYWORDS: *usability, web-design, geo-web interface, cultural heritage portal*

INTRODUCTION

A number of possible definitions of usability are available in the literature, and the needs of geo-web usability studies have been compared and contrasted with broader data-related activities of providers and users of geo-information. For example, one official definition of usability is given by the ISO 9241-11 standard on Display Screen (VDU) Regulations, Use of Ergonomics for Procurement and Design (ISO, 2002). In this definition, system usability comprises " the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use, where:

- Effectiveness measures the accuracy and completeness with which users achieve specified goals;
- Efficiency measures the resources expended in relation to the accuracy and completeness with which users achieve goals;
- Satisfaction measures the freedom from discomfort, and positive attitudes towards the use of the product."

Usability elements outline the features and characteristics of a geo-web interface that influence the learnability, effectiveness, efficiency and satisfaction with which users can achieve specified goals in a particular environment. The context of use determines the types of users, tasks, equipment, and the physical and social environments in which a geo-web interface is used. Therefore, a usability study consists of users (i.e. the people who interact with the geo-web interfaces), equipment (hardware, software and materials), tasks (activities required to achieve a goal) and a physical and social environment, for the purpose of achieving particular goals. More recently, Nielsen (2000) stated that “Usability rules the Web. The web is the ultimate customer-empowering environment. He or she who clicks the mouse gets to decide everything. It is so easy to go elsewhere: all the competitors in the world are but a mouse click away.”

In this paper, we focus on usability as it stands for the measure in which the contents and human-computer interaction of a geo-web interface enables a user to satisfactorily carry out his/her task in a set environment. The main motivation behind this research work was driven by the W3use, which has set up 10 main usability elements that facilitate the production of usable internet sites. Such web usability elements have also previously mentioned by Nielsen (2000) and Vroom (2002). They include recognition, navigation, speed, search, layout, style of writing, hyperlinks, interaction, accessibility and pictures and multimedia. Many of these usability elements can be applied directly on sections of web sites/portals in order to disseminate geo-information. However, specific studies on determining these elements for geo-web usability

are non-existent. One of the few studies on geo-web usability was carried out by Poppe (2001). By means of questionnaires he investigated the usability of route planners using CDROMs and the Internet. The maps generated by the route planners were also subject of his research. However his conclusions focused on the content of the maps (place names, street names and road numbers have to be in the maps) rather than the usability of the maps.

Therefore, this paper describes our first approach to uncover the main elements of web-usability of geo-information (Figure 1). Three main elements have been identified as being web content, human-computer interaction, and user satisfaction (Hunter et al. 2002). The web content is related to the completeness, relevance, and status of geo-information available at a web page. Many definitions of Internet maps are currently being proposed and they include some aspect of increased map use by user interaction, visualisation, or spatial analysis. Some examples include geographic visualisation (MacEachren 1992) and on-line mapping visualisation – OMVIS (Crampton 1999).

Moreover, the human-computer interaction describes the possibilities of a user to link up with geo-information by using functionalities, intuitivenes, and relevance. For interactive maps most of the interactive functions attempt to mimic the cognitive map (Peterson 1995) and they are similar to GIS functions. Many interactive Internet maps have the GIS functions such as zoom, pan, identify, proximity, theme selection, and others. As GIS technologies develop many of the new functions are expected to be included in Internet maps. GIS software is usually used to generate and distribute Internet maps. According to Peterson (1997), MapQuest (http://www.mapquest.com/) became the first largest provider of custom Internet maps in the world, generating millions of maps a day. The primary interactions were geo-coding, fastest route calculations, and tabular and graphic representation. All of these functions were part of a GIS toolbox implemented on an Internet map. Therefore, GIS can be considered a critical design component for Internet mapping in the context of enhanced human-computer interaction.

Finally, user satisfaction can be determined by the rate of frustration, awareness of possibilities, and the time necessary to master a new functionality. However, it is important to pint out that user satisfaction depends on several social and cultural backgrounds of users. For example, a product or service developed in one region can be adopted and used in unexpected ways in different cultural contexts. An international or intercultural geo-web usability research is currently needed; and although is a topic that is often ignored but much needed for the global GI marketplace.

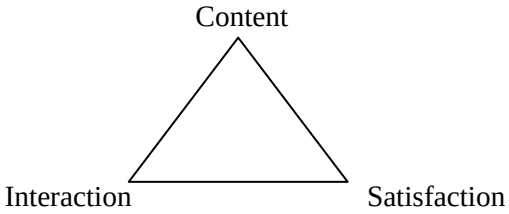

Figure 1*: The main elements of geo-web usability*

This paper will describe how these three main elements have been measured in a usability test that has been performed for the Portal of cultural heritage in the Netherlands (KICH). The focus was given to the geo-web interface of the KICH Website. The next sections describe the set up of the usability test and the results after taking into account four sections of the geo-web interface.

THE USER NEEDS

The user needs came from the consortium of four parties who work on cultural heritage in the Netherlands, and decided to build a knowledge infrastructure for the cultural heritage of the Netherlands (KICH). In 2004

the first step was taken by setting up a web portal from which professionals were able to retrieve spatial data, find experts and documents in the field of cultural heritage. With professionals is meant people who have professional interest in cultural heritage, such as spatial planners, city planners, and archaeologists, local, regional and national governments, property developers, builders, and GIS specialists. This list of potential users already shows the diversity of the target group of the portal, which was also the main problem regarding setting up the portal and trying to make it usable for everyone within the target group. The most important part of the portal is the Geo-web section in which all available spatial data is meant to be viewed, browsed and queried. This is also the section that is expected to be most challenging regarding the usability, because the portal is to serve specialists as well as laymen in the spatial domain.

The first version of the Geo-web section of the KICH portal was used to carry out our usability test (Figure 2).

***Figure 2**: The KICH Portal*

THE USABILITY TEST

In the Netherlands more and more companies offer usability tests for websites. One example is the 2C Communication and Consultation, which holds a yearly competition of the most usable website. This year the site www.funda.nl (a website offering real estate information to everyone in the Netherlands) won this competition. Ten sites were selected by election via the web and the final decision was made by a specialised jury. It is already the fourth year in a row they carried out this competition.

The usability test of the KICH geo-web site was organised by 2C Communication and Consultation, which developed scripts containing tasks to be performed by the respondents. The tasks were determined on basis of the purpose of the KICH website. For the usability test, six respondents were invited and expected to raise and identify 85% of the usability issues (Nielsen, 2000). Besides, it was the experience of the 2C that with such a small number of respondents more than 90% of the usability problems of a website can be found.

Before the usability test took place, the users were asked some general questions about their experiences with Internet, their general way of finding information and their expectations concerning the portal. Every respondent had an hour and a half to work through the script under the supervision of a specialist from 2C. The tests took place in a test lab consisting of two rooms. The rooms were separated by a non-transparent

window, similar to interrogation rooms of a police station. The respondents and supervisor could carry out the test, while in the other room all the screen actions (mouse and keyboard) of the respondent and the conversation between the respondent and the supervisor could be followed by others. The complete test was recorded on video and all the actions performed by the respondent on the terminal. As an important requisite the respondents were told to think aloud as they carry out the tasks. Another important condition set by the supervisor was that the respondents were always right. So if the respondent could not find or work with certain functionality this would mean that this functionality was not clearly or intuitively implemented in the geo-web interface. The supervisor on his turn should listen very well, never take a lead and should always stay neutral.

Therefore, the geo-web interface was implemented in such a way only one web page has the functionality of the map viewer in a comprehensive form. The usability test was then carried out on this initial geo-web page (Figure 3).

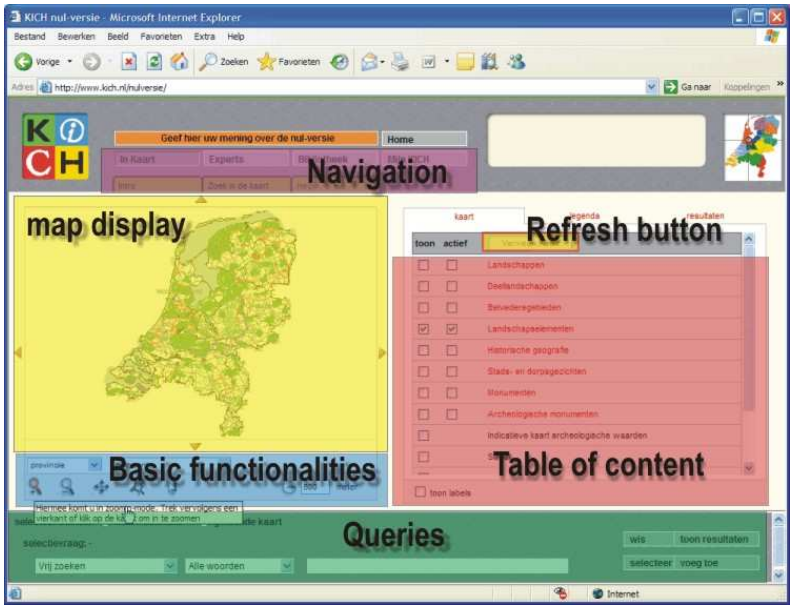

***Figure 3**: The geo-web interface used for the usability test*

We consider four typical sections of a geo-web user interface as being one of the following:

- Map display (i.e. the map viewer) where the Internet maps were shown;
- Table of content where information layers could be visible and/or active;
- Basic map functionalities which were used to allow the respondents to interact with the Internet map displays (zoom, pan, info buffer, etc);
- Query box which were used to query basic information about the information layers in the database (Figure 4).

***Figure 4**: The query box*

THE MAIN RESULTS

The results discussed in this section are mainly related to the geo-web page of the portal, on the basis of the respondents' findings and the comments provided by the 2C Communication and Consultation (Broek et al. 2004). They are:

Map display

The most common remark of the respondents was that the area showing the map was far too small (Figure 5). A clear idea about the location being displayed on de viewer was not always possible because of the limited extent. Geo-information was hidden by polygons that were stacked on top of each other, mainly because the respondents have to use many map layers containing solid filled polygons. Although hatching was used to show overlapping polygons, an unclear map view was the result when showing these layers at the same time. The respondents were easily confused by all the lines crossing each other. Respondents had also difficulties finding the 'refresh map' button or to renew their modification made in the table of content.

The results above raise issues about the appropriateness of current web contents when dealing with Internet maps. Maps provide a clear means of showing the spatial relationship between people, events, actions, objects and ideas. By placing all of these entities on an Internet map it is expected that large numbers of people can make decisions about what is around them and how it might affect them. However, for an Internet map the intent of the user must always be considered, and as a result, what specific information is actually needed to be presented.

The following suggestions were made to improve the Internet map display of the geo-web interface:

- the location of the button to refresh the map should be obvious;
- the map display area needs to be enlarged;
- when moving over certain objects on the map, information should be given in mouse-over text;
- the order of the layers should be changed to avoid their overlap. The active (i.e. the searchable) layer (s) should be always placed on top;
- a scale bar should be added to the interface;
- the legend should be available by means of an association with a bottom of the map.

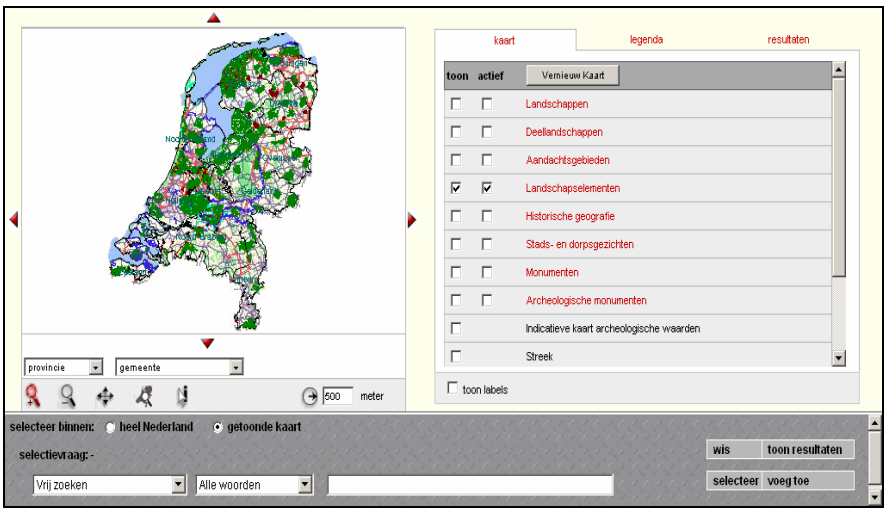

***Figure 5**: Map Display and Table of Contents*

Table of contents

The main comments were directly related to the map display of the web page. The difference between 'show' the layer and make the layer 'active' was unclear to the respondents. 'Show' does make the layer visible and 'active' makes the layer searchable. Therefore, the following suggestions were made:

- show layer and make layer active should be the same despite the loss of functionality;
- show reference maps (for orientation) should be separated from information layers.

Basic functionalities

The respondents were not familiar with the icons used by the geo-web interface as well as the way the basic functionalities were supposed to work (Figure 6). Besides, they were confused by the shape of the mouse pointer which did not change when selecting another function. The following suggestions were made:

- the use of larger buttons around the map,
- avoid the use of icons but text
- the use of a function-specific mouse pointer
- make all the buttons functions consistent
- the use of print-friendly versions of the map and legend.

These results point out the fact that we can not expect users to be familiar with GIS functionalities. In other words, the current implementation of geo-web functionalities based on GIS functions are not supporting the user needs in terms of human-computer interactions needed for Internet map displays. The results show very low user satisfaction on this usability element.

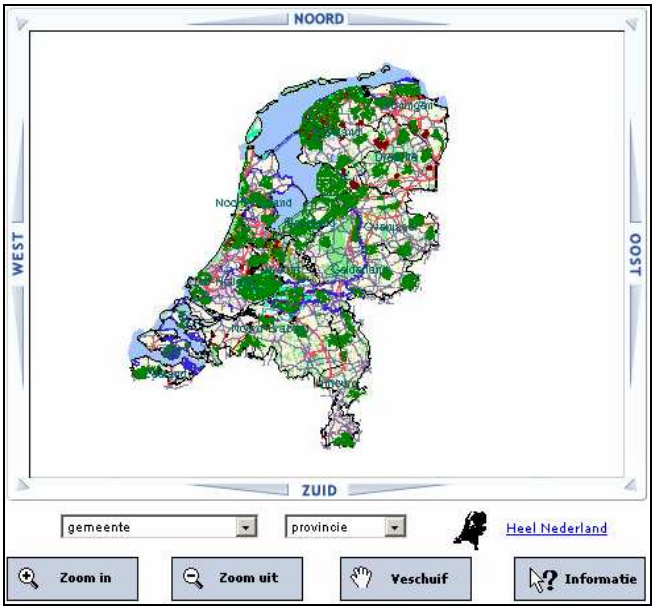

***Figure 6**: Basic Functionalities*

Queries

None of the users were able to make a query without help. The main problem that occurred was the complex structure of the pull down menus and fields, and the terms used on the buttons. In the design there was a difference made between 'search' and 'select'. 'Search' means showing a set of found objects as a result of the use of a map tool and 'select' means showing a persistent set of found objects as result of a query and have this set available for further queries. This was not clear for all of the respondents. The following suggestions were made:

- Start the query with an open search text field
- Remove extended search functionality
- Open the result pages as soon as the button 'search' has been pressed
- Give the search results clearly
- Add a link 'extensive searching' in which the user can select from different search possibilities (all words, exact word combination, one of the words)
- Open extensive searching with the given search question
- Delete all other extensive search options
- Use 'search' instead of 'select' and do not make a distinction in its functionality

CONCLUSIONS

Testing usability for geo-web portals needs a special approach. Browsing a map in itself is already a complex matter. Therefore special attention must be given for designing geo-web interfaces. In this paper, the presented usability test gives insight on web contents and human-computer interaction using Internet maps. It also shows the complexity of Internet map browsing and querying, and how difficult is to carry out them intuitively. On the other hand, the results show that browsing spatial data using an interactive Internet map is very promising compared to traditional static (and often analogue) maps. There is a strong relationship between user interaction and user satisfaction, rather than the web content element.

Some geo-web interfaces will be more useful than others in the future. This will be a consequence of the nature of the elements being depicted (i.e. interaction, content, and satisfaction) and the temporal and spatial scales of geo-information. Accordingly, considerations will have to be made about the best way of improving the use of the geo-web interfaces by defining the trade-off among interaction, content, and satisfaction. On the basis of the results from this usability test, we are able to point out the need of a usability framework that can distinguish the main usability elements for the application aiming to extend the lifespan of geo-web interfaces within reasonable limits. This framework will affect the way data sets are produced, maintained and used. There is also considerable scope for the implementation of new functionalities beyond map display, query, and basic functionalities.

The findings from our usability test will be used to the design of the public version of the KICH web portal. More usability tests are envisaged to further improve the geo-web interface of the KICH portal. In this process we hope to define clear design criteria for designing geo-web interfaces in general.

Finally, there is an important element linked to the way users perceive and use existing geo-spatial data sets. The same data presented in an unfamiliar way to the user seem to fail their usability. The human-computer interface is an important area for constant improvement. Some visualisation techniques like 3-D representations, virtual reality and animations seem to bridge the gap between data producers and data consumers. Therefore, these techniques improve the likelihood of these data being fully understood and used.

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