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ANNEX

EVALUATION OF SOFTWARE COMPONENTS ON THE BASIS OF 3 SAMPLE SEARCH INTERFACES

1.   Proposition

Over the past twenty years, the internet has become an integral part of the culture of the so-called western countries, increasingly dominating fields such as communication, information, and education. In particular, the possibilities for publication of documents on the internet has opened up new possibilities and sources for accessing information and publishing one's own knowledge.

The structure of the WWW, with its vast amount of data organised in hypertext documents, means that content can only be registered mechanically. Search engines thus play a pivotal role in the search for information in the internet. They search mechanically, with robots substantially the WWW, but to a lesser degree also newsgroups and public FTP-servers, and save the URLS and other metadata of the websites found in their databanks. In view of the size of the WWW and status of the documents themselves, which are only mechanically indexed, of unverified content and only poorly structured, it is highly questionable how reliable the offered information really is. This goes for the information itself, as well as the method the search engines use to seek and present the information. Since the criteria for the findings, and the sequence in the presentation of the results for a search, are not laid out openly by the people running the organization, thereby making the relevance of the displayed results difficult to comprehend and follow, this leaves an element of uncertainty as to whether the search engines are delivering a neutral and wide spectrum of results.

On the other hand, it is necessary that people using search engines acquire a sufficient competence to operate them in a way that allows them to extract productive information and uses from them. A search engine, however easy-to-use the interface may be designed to be, is not a self-explanatory form of software. To retrieve useful results, it is not enough to know the function, i.e. the possibilities and boundaries of the search engines. It is necessary to learn how to accomplish a successful internet research.

This is where the project SEEKS comes into play. SEEKS is an acronym for Adult Learners Information Seeking Strategies in the Information Society. This project was commissioned in the framework of MINERVA Open and Distance Learning (ODL) and ICT in Education, which is part of the European Socrates Programme. It sets out from the question of how users of search engines behave during a search through the web, whether they follow a certain strategy and if so, whether they are successful with it, meaning whether the desired information the person is seeking has been found. The SEEKS project also raises the question of what is needed in terms of education and knowledge, especially for people who have no regular access to the internet and for those in danger of long-term social disadvantage. It is to indicate solutions to the questions how and what people need to learn in order to take part in the process of lifelong learning and to satisfy personal and work-related information needs with the help of the internet.

All partners in the SEEKS-project conducted national case studies that examined the behaviour of learning adults during a search. A research framework based around Wilson's search model[1] and a pilot study devised by the University of Barcelona[2] served as methodological models for the initiation of the experimental setting.

Why "Guidelines for Developers"?

Developer is meant here in a wider context. In the technical sense it is about "system designers", as well as those "developers", who play a decisive role in the concept and contents of learning environments as teachers, university lecturers, and tutors.

The recommendations outlined here are thus divided into two categories. Firstly, indications are given in short forms for the design of search interfaces, so that system designers receive an informative starting point for the development of a search interface. This concerns developers of

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1 see Projectwebsite: http://www.seeks-it.net/outputs.html „Reviewing the Research: a discussion towards a methodological framework"
2 http://www.seeks-it.net/Assets/Docs/2DEL2Seeks.pdf

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search engines as well as designers of web portals, in other words, information systems in general, who have the task of developing a search function. They receive, through these guidelines, indications about the functions that assist users in their search. It is, however, an illusion to think that there is a single way to design the real search interface. There is no "right way". The differences that users bring with them regarding their experience and knowledge, the type of information which is being sought-after, the way the results are presented and the amounts of information that are being scanned are only some of the variables that make it impossible to create the ideal search interface. These guidelines can give some indications, which can be drawn from the results of the case studies, how some difficulties that participants encountered during the trials, could be avoided.

Secondly, there are recommendations for the teachers and tutors, to show ways how media competence can be acquired for the usage of the internet. This is because one of the most important results of SEEKS lies in the realisation that – besides the relative subject/domain knowledge – the user's degree of knowledge of the internet generally and search engines in particular is decisive for a successful search. It centres around the idea to convey concepts and problems of searches and to develop search strategies for a variety of information needs.

The main focus therefore is on proposals regarding learning steps, to contribute, depending on ones previous knowledge, towards the acquisition of knowledge which should render searches more successful and to critically judge the results presented by the search engines.

2. <u>Introduction</u>

After a brief introduction, the following is divided into three sections:

a) *"ODL systems and information seeking"* , which gives a description of various learning modules which can be used to learn efficient search strategies for information searches on the Internet, and includes some comments on possible ways of implementing these learning modules in virtual learning environments.

b) *"Does superior search engine usability lead to better support in a search?"* discusses the ergonomics, navigation and design of interfaces in search engines and what influence, if any, a good interface can have on the success of a search.

c) *"Evaluation of software components on the basis of three sample search interfaces"*, a comparison is made between Google, Teoma and elearners.com. The aim of this comparison is to illustrate through examples the knowledge that can be transmitted to learners and the criteria that can be used to evaluate search engines. It is also made clear, in abbreviated form, why Google is currently the most successful search engine.

The SEEKS experiments and the concluding questionnaires led to the conclusion that the participants mainly paid attention to the following parameters in respect of the possibilities of the search interface and the insertion of search terms:

- simplicity
- clear interface and convenient navigation
- language.

With regards to the result lists an important role was played by:

- credibility, reliability and relevance of the results
- language.

The success of a search – measured by the degree of satisfaction of the participants and whether the desired information was found – was also affected by the participants' own:

- ability to differentiate between two kinds of information need and to then choose a starting point for the search
- knowledge of websites which are topically linked with the desired information
- knowledge about search engines and of the art of searching
- knowledge about the Internet
- knowledge about the relevant topic of a search for information (domain knowledge)

These conclusions confirm preceding experiments and theories that, essentially, there are three kinds of relevant knowledge components which contribute to a successful search:

- system expertise
- information-seeking expertise (to develop a strategy for a search task and the course of the search)
- domain knowledge[3]

It was interesting to note that the majority of participants did not evaluate or check the information they found.

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[3] cf. Marchionini 1995; Weber & Groner 1999.

This brings up two questions:

(a) the extent to which search engines and portal sites that offer search possibilities pay attention to the parameters listed above, and

(b) the extent to which it is possible to increase the abilities of searchers through, among other things, ODL systems.

First the latter point will be addressed and then several search engines and portals will be described and then heuristically evaluated.

3. <u>ODL systems and Information Seeking</u>

Of the knowledge components listed above, two - system expertise and information-seeking expertise - are of interest in any kind of training aimed at increasing a user's information-seeking ability on the Internet. Attention should be paid to particular learning targets and contents, regardless of whether the software is to be made available online (Online seminar, web workshop) or offline.

Learning targets:

- to gain knowledge about the Internet and the functionalities of search engines
- to learn about search strategies
- to learn how to judge credibility, use and relevance of sources of information.

The following modules[4] would be possible:

- **Module 1:** Search environment
  - o Internet (*What is the Internet?*)
  - o WWW (*What is a homepage?*)
  - o Search systems (*What is a web catalogue?*)
  - o Syntax of URLs
- **Module 2:** Finding information on a website
  - o Help on websites (e.g. search, sitemap)
- **Module 3:** Search tasks
  - o Set and discuss search tasks of varying difficulty
  - o Use of search systems and phrasing of searches
  - o Recognising and formulating differences between search engines (search systems) and make use of them for the search at hand.
- **Module 4:** Determining and evaluating providers
  - o Identification of providers and evaluation of their credibility and topicality
- **Module 5:** Analysing the search task
  - o Determine and work on parts of the tasks
  - o Which search system is best suited for seeking which information
  - o Possibilities and limitations of searching on the Internet
- **Module 6:** Improving the search techniques
  - o The art of formulating questions: reducing ambiguities
  - o Standard search – extended search
  - o What can one search for (what type of documents are indexed)?

The module tasks could be developed for different levels depending on the age and target group, and modules could be added or left out (e.g. use of online databases) according to background knowledge. In the case of an online seminar, assistance with the respective modules would be of help.

Looking for information on the Internet is a complex matter and requires thorough preparation or training. Simple information pages or help texts are not suited to the complexity of the subject – quite apart from the minimal pleasure and the not exactly high educational value of fighting one's way through masses of text online or at least on-screen. On the other hand, it is impossible to avoid acquiring basic knowledge.

How this knowledge is transmitted depends on the type of online event (virtual teaching) or learning software planned. Virtual teaching can offer various functions depending on the degree of active communication, such as the following[5]:

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[4] cf. Tina Schorr: Kompetente Informationsrecherche im World Wide Web, unpublished, http://www.vgk.de/projects/schorr/ (27.01.2004)
[5] cf. Schulmeister 2002

1. information is made available on the WWW and the data can be downloaded
2. asynchronous communication via message boards (forums)
3. synchronous communication (e.g. chat)

The following comments give some ideas as to which pedagogical methods could be better suited to which function of virtual teaching.

On 1
If nothing more than information on the WWW is made available, then not only linear texts but also hypertexts can be considered. Here it is the transmission of knowledge of facts that is important.

Components that could be used:

o   offering material, texts, graphics or links that contain the content to be learned
o   offering teaching software that can be used via a browser

Modules 1, 5 and (to some extent) 6 can be combined with this type of knowledge transmission.

On 2.
Communication taking place via web forums in relatively small groups (6-10 participants) are well suited for allowing the learner to learn actively and independently. Tasks may be set which can be solved either together or in individual parts.

Another possibility is a quiz that contains search tasks and can be used to try out and apply the knowledge learned.

It is recommendable to offer assistance for the groups so as to support the participants in working through the contents and motivate them towards successful learning.
Modules 2-4 and (in part) 6 can be combined with this type of knowledge transfer.

On 3:
A chat is suitable for discussing topics or accomplishing tasks together at the same time. The idea of working together demands a lot from the software, since chat systems up to now have not been designed for working together on, say, text documents. In my opinion, offering synchronous communication only seems suitable as an additional module to one of the two possibilities of online teaching described above.

4. <u>Does superior search engine usability lead to better support in a search?</u>

4.1 Introduction

In the last few years, the subject of usability and interface design has been an important topic for psychologists and information scientists, as well as for graphic designers and even computer scientists. These guidelines will not represent the entire current and past discussions on this topic. The aim of this chapter is to demonstrate the results of our study with regards to the design of search interfaces and to deduce criteria for usability from it. Throughout this, it will become apparent that these criteria were developed in the context of current theoretical developments.

4.2 Problems

Search engine technology still shows a range of insufficiencies, which cannot be compensated by even the best interface. The Internet user can only evaluate the results of his search and correctly appreciate their information content if he knows about these insufficiencies.

The following list shows the basic current technological problems:

- There is no content quality control in robot generated search engines
- The results list is influenced by search engine spamming
- The algorithms determining the relevance of the hit list are unknown
- The extent of indexed websites that are used by the search engine and the extent of all existing websites are unknown
- New, unknown or less linked websites might not be found

4.3 Searching & Interface

Via the interface, searches are conducted and the results of the search are shown there. This means that the design of the interface plays an important role in a successful search. The process of searching goes through several phases, as is made apparent by the Internet Information Seeking Model:
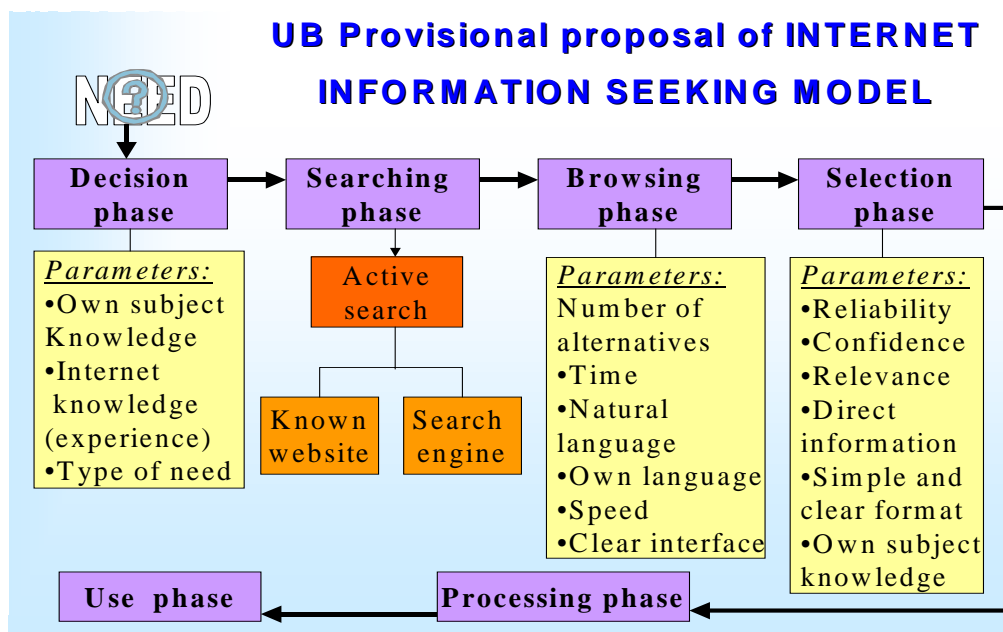
These phases are characterised by the following actions by the searchers: One or more search terms are entered into a grid designed for this and the search is then started by pressing a button. The search is followed by a response from the search engine, which displays hit lists. These hit lists are then checked by the searchers for their relevance in answering their information need.

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They have to decide which steps to take next, whether to terminate the search, because they achieved their aim, whether to view a document in more detail, because it seems relevant, or whether to view a document at a later stage.

The searchers have to decide which implications result from the information, whether to formulate a new search, whether and how the problem could be defined differently, whether the search should be terminated without achieving the task.

Searchers expect no hits, one hit or little information on one topic, but are often confronted by hundreds of hits. When many results are shown, they are usually displayed as a list with different specifications about the type of document. The way in which these specifications are organised and presented influences how information searchers check the separate hits, evaluate their relevance and decide what to do next. The higher the amount of hits, the more important becomes the kind of presentation[6]

In order to facilitate the searchers' task to decide about further steps quickly and correctly, it is important to present search results in such a way that they support this decision making process as effectively as possible. The interface should provide useful hints to explain search results, to support the evaluation of results, the extraction of information and reflection[7]. For this, the following aspects mainly gain importance, as shown in the studies:

- Specifications about the found documents: The exit interview showed that users want to get an impression of what a found URL address contains: a website with information on the topic in question, a site with links, a site in your own language or in a foreign language. Users want a list with keywords or a short summary of the respective document.
- Structuring the information: A categorisation of links, such as it is done on Vivisimo (http://vivisimo.com/) or on Mooter (http://mooter.com) is desired.

4.4 Interface Design & Usability

The studies within the framework of the Seeks project have shown that most users want a simple search with the help of an interface that is reduced to the essential minimum – the possibility to enter a search term in a field designed for this. In addition, they wanted a significant, but easily manageable hit list. It is the fast, informative result that counts. This means, that the search site only has to fulfil minimalist tasks, as many searchers are not interested in performing complicated processes in order to start a search. In addition to general criteria for usability, which can be used for almost any website and are described in the chapter 'Heuristic evaluation', the interface of search engines should fulfil the following requirements in order to make the search easier for users:

1. User interface for the entry of search terms:
   - There is a simple default search and a search function for experts (Advanced Search)
   - There are clear, short examples for different search options, e.g.:
     - The use of inverted commas during the search for phrases or names
     - The use of Boolean operators
   - Sites offering help and explanations are linked clearly visible
   - The search engine recognises typos and deals with them

2. Presentation of the search results
During the studies, the following results could be perceived with regard to the examination of search results by the participants:

   - Uncertainty with regard to the choice of qualitative information
   - The decision for choosing one link was basically based on the short descriptions which are presented with the link, although these descriptions were thought to be insufficient

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[6] cf. Marchionini 1995

[7] cf. Unz 1999

- Further criteria for the choice were the name of the website and the (assumed) respectability of the URL

It is apparent, that the short summaries play an important role in the process of evaluating search results. These and the presentation of the search results in categories are decisive factors facilitating (at least subjectively) the search for information and the choice of results. In this respect, the results of the Seeks studies are in agreement with other studies[8].

Although further analysis examining the strategies of searchers in evaluating the link lists of search engines is necessary, we can assume, on the basis of existing results, that the following activities are undertaken, either alternatively, in parallel or after one another:

- Scanning of the hit list
- Quick check of the hits by clicking on the links, as the information provided is insufficient to decide on relevance and subsequent return to the search results
- Analysis of the title of websites
- Analysis of text summaries
- Analysis of the URL

The design of the hit list should be concentrated on the presentation of text summaries, the title of the website and the URL whilst paying attention to the following elements.

- Titles which show where the search term is in the found document (e.g. by adding chapter titles)
- Points which show the proximity or distance of the search terms within a document

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[8] cf. Wirschum 2003

5. __Conclusions__

The SEEKS project - Information Seeking Strategies of Adult Learners in the Information Society – was concerned with search engines and the behaviour of their users. The results made evident, not only for developers of search engines, search interfaces and learning systems, but also for teachers, the problems arising within the following areas:

- The allegedly easy access to the internet and the search engines does not excuse anyone from the necessity to learn its effective use and to improve the user-friendliness.
- Search results often do not fulfill the expectations of the users due to various reasons (poorly conceived technology and/or so-called spam on the one hand, lack of knowledge of the users on the other hand)
- Search engines only ever detect a greater or lesser proportion of the full range of websites available on the internet.
- The reasons for the presentation of certain search results and their sequence is not comprehensible.

An obvious answer to these problems, which would at least make users more competent, is **literacy, literacy and again literacy** (in the sense of education). A part of these guidelines points in this direction. A specific problem is the so-called *"Production Paradox"*, which consists of users often not being willing to learn basics, if this learning process seems to hold them up in reaching their primary goal. This corresponds to the poor readiness to read help texts from computer programmes or in this case, search engines[9]. Computer programmes, like the use of search engines appear as something not worthy to make the effort of learning. An apparent "intuitive handling" encourages this way of thinking. However, intuition depends on what is known and with what analogies can be built. If the analogies are incorrect, then the use of software will inevitably lead to disorientation Against this background, it is important for developers and software designers firstly, to prevent the illusion for users that relevant information can be found without any effort, and secondly, to improve the user-friendliness and added value of search engines in such a way that they are easy to comprehend and only search, doing this to a good standard, with simple functions and offers for inexperienced users. More research is required to find out, in detail, how and in what way effective use by the users can be supported. It is possible to imagine intelligent (virtual) dialogues, that assist to narrow down even further the search request[10].

Guidelines can however only make sense where the social environment and the political framework is given, within which they can be implemented. This concerns the educational establishments, which not only have to provide the means to develop learning units to teach media skills in schools and advanced training facilities, but also teachers who must realise that the ability to research through the internet is an educational value, as essential as being able to read and write. This also concerns other media and information services in the internet (e.g.:www.searchenginewatch.com), which must take on the role of describing the background, functions, and problems of search engines, thereby fulfilling their educational duty. And it also concerns the political will to provide independent scientific bodies with the means to critically supervise search engines and their functions and especially to monitor their neutrality regarding the presentation of the search results. Secondly, there must also be a political will to encourage and support educational establishments that offer courses covering media, or teach, as described above, the use of the internet and how to search effectively in it.

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[9] cf. Hölscher 2002

[10] cf. Machill & Welp 2003

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Annex:

Evaluation of software components on the basis of three sample search interfaces

1.   Google, the search engine

1.1   Conception

The search engine Google.com, a robot-generated index, emerged in 1998 from a university-based project by Sergey Brin and Larry Page, two PhD students in informatics at Stanford University[11]. The name Google is derived from Googol, the mathematical term for a set that matches 10^{100} (the figure one with 100 zeros)[12]. Nowadays, the company Google Inc.,a non-listed company, runs the Internet service with about 1000 employees. Its investors and associates include, apart from the founders, traditional investment companies, as well as numerous figures from the American IT industry, such as Andreas Bechtolsheim, the founder of the computer manufacturer SUN Microsystems[13]. The index of the search engine presently contains more than three billion web documents, as well as more than 425 million pictures and more than 800 million Usenet contributions. Google answers more than 200 million searches per day[14].
Google's aim is:

> *Google's mission is to deliver the best search experience on the Internet by making the world's information universally accessible and useful. Google, developer of the world's largest search engine, offers the fastest, easiest way to find information on the web[15].*

The search engines service is not just restricted to WWW documents. Apart from the full-text search via the web index, the start page also offers searches for images, for contributions on the Usenet and searches in a manually compiled web catalogue or in current news.
As Google wants to provide universal access to information, every Internet user is part of the target group:

> *A Google user might be a woman in Atlanta trying to decide what car to buy. Or a doctor in Osaka looking for the latest study on an unusual illness. Or maybe a business executive in London researching a competitor[16].*

In order to live up to this claim, the user interface of the search engine is available in 88 languages and is consequently also of use to those users who cannot speak English.
Google concentrates solely on searches. Unlike with other providers of search services on the Internet, there are no other contents:

> *It's best to do one thing really, really well.*
> *Google does search. Google does not do horoscopes, financial advice or chat[17].*

1.2   Characteristics

One of the specific characteristics of Google.com is, that besides web documents in HTML format, documents in the following formats are also listed on the index[18]:

- Adobe Portable Document Format (pdf)
- Adobe PostScript (ps)
- Lotus 1-2-3 (wk1, wk2, wk3, wk4, wk5, wki, wks, wku)
- Lotus WordPro (lwp)
- MacWrite (mw)
- Microsoft Excel (xls)
- Microsoft PowerPoint (ppt)
- Microsoft Word (doc)
- Microsoft Works (wks, wps, wdb)
- Microsoft Write (wri)
- Rich Text Format (rtf)
- Text (ans, txt)

Google also holds a monopoly on the possibility to extend a search to Usenet contributions and current news.   A further important characteristic of the search engine is its patented PageRank-algorithm. This algorithm works in the following way:

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[11] cf. http://www.google.com/corporate/timeline.html

[12] cf. http://www.google.com/corporate/index.html

[13] cf. http://www.google.com/press/investors.html

[14] cf. http://www.google.com/corporate/facts.html

[15] http://www.google.com/press/overview.html

[16] http://www.google.com/corporate/index.html

[17] http://www.google.com/corporate/today.html

[18] http://www.google.com/corporate/facts.html

It assumes that the more links refer to a website, the higher the authority of that website will be. It resembles the procedure in the scientific field. An author that is cited more often will automatically be attributed a higher status of authority and qualification. The rating of the websites is dependant on the number of links it refers to and is then compared with its authority. The higher the authority of a referring website, the more it contributes to the authority of the targeted website. Since it is an iterative algorithm, all pages are initially given the same authoritative status and in the next step, a new status of authority will be allocated to the sites through the link system. In doing so new values will be created (cf. Page et al. 1998). This drastically increases the quality of the hits. An interesting function is the display of cached web documents. With this, documents which are not available online anymore can be displayed. The plain, free of promotional banners design of the service is another characteristic. However, the hit list shows contextual text advertisements rather than the usual promotional banners. These are in direct context with the inserted search terms. This service is provided by Google under the trade mark „AdWords"[19]. Apart from the simple search grid on the start page of the service, the user can also resort to the advanced search. The user interface of the search engine is characterised by its minimalist design. On the start page of the service, the logo is positioned in the centre on a white background. Normally, it says „Google" in several colours. Directly underneath it are the five main navigation points in form of symbolic tabs:

- Web – Search the World Wide Web
- Images – Search for images on the World Wide Web
- Groups – Search for contributions on the Usenet
- Directory – Search the manually compiled dmoz-catalogue of the Open Directory Project
- News – Search for news

Underneath the navigation points, one can find the simple search grid with the "Google Search" and "I'm feeling lucky" buttons. Whereas the "Google Search" button starts the search, the "I'm feeling lucky" button automatically leads to the website of the best hit for the search. Next to the search grid, there are three links leading to the advanced search, preferences and language tools. At the end of the site, there are four links in text format with information about the company, which are irrelevant for a search, as well as the copyright notice declaring the number of currently indexed pages. Occasionally, another link is displayed, which leads the user to the corresponding foreign language version, depending on in which IP address area he moves. The minimalist design is continued on the result page. Next to the logo, which now appears smaller in the top left hand corner of the screen, you can find 4 links and the search grid, in which the search terms are displayed. The links lead to the advanced search, the preferences, the language tools, as well as to an extensive help site. Here as well, symbolic tabs with the choice of sources give the finishing touch of the header. (Web, Images, Groups, Directory, News). The search term is highlighted in a coloured bar. The total number of documents found and the number of listed hits is also displayed. The bar also states the time the search took. If the search term can be assigned to a category in the catalogue, the corresponding catalogue is displayed as a link to the Open Directory. If there are news concerning the entered search term, the news titles are listed as a link. In addition, the entered search terms are run through a spell check. If the system finds an alternative to the search term, it is suggested.
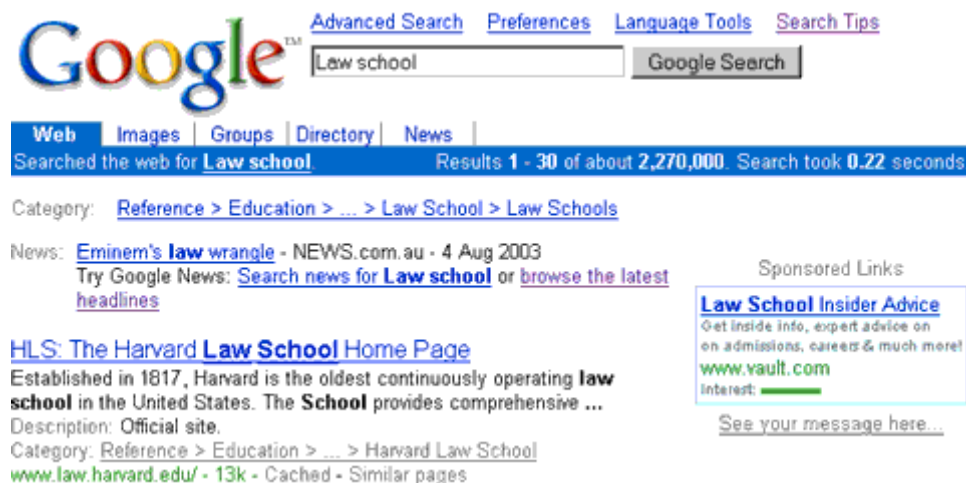
A hit listed by Google has the following characteristics:
The title of the found document is highlighted as an underlined link. In some cases, there might be the *"Translate this page"*, link next to it, which leads to the automatic translation of the found document. This link is only displayed for hits, where the documents are in another language than the language used in the user interface. Google provides the translation. Underneath it, a few words from around the search term are given. The description line gives part of the information, which is stored in the Meta tags of the HTML code of the site. Underneath this, the link to the corresponding site in the catalogue might be repeated. Finally, the last line displays the exact URL and the size of the found document. The *"Cached"* link leads to a cached version of the document. *"Similar Pages"*, finally, leads to a result page with similar hits.
Clarity and minimalism in design are ideals to which Google aspires[20]:

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[19] cf. https://adwords.google.com/select/?hl=en
[20] http://www.google.com/corporate/today.html

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Focus on the user and all else will follow.
From its inception, Google has focused on providing the best user experience possible. [...] Google has steadfastly refused to make any change that does not offer a benefit to the users who come to the site:

- *The interface is clear and simple*
- *Pages load instantly*
- *Placement in search results is never sold to anyone*
- *Advertising on the site must offer relevant content and not be a distraction*

2. The catalogue eLearners.com

2.1 Conception

eLearners.com is a specialised catalogue. It is aimed at American internet users, who want to gather information about E-Learning courses and degrees. ELearners.com wants to be a marketing platform for providers of said courses and degrees[21]:

> *eLearners.com serves the online learning community by helping online learners find the most appropriate e-learning providers for their needs. We provide services that help on-line learners succeed while helping providers market their offerings.*

The catalogue is run by eLearners.com Inc., a privately owned company based in Hoboken, New Jersey, which was founded in 1999. eLearners.com lists over 760 online courses leading to a degree, as well as over 7400 other online courses in 375 topics in its catalogue. The company expects to bring together more than 2.5 million potential participants with providers of online degrees and courses[22]. Accordingly, the internet service aims to provide a commercial platform, where demand (potential participants) meets offer (providers of E-Learning programmes). The provider is charged for admission to the catalogue[23].

2.2 Characteristics

At first, it has to be said that the catalogue exclusively contains American E-Learning offers.
There are four main categories, which can be searched:

- Courses & Tutorials - Search for thousands of courses & professional training
- Degrees & Programs - Thousands of online degrees & certificate programs
- Accredited Higher Ed. - Accredited U.S. Higher Education Schools, Degrees & Courses
- Training & Continuing Ed. – Professional Training & Continuing Education Courses, Certificates & Programs

In all of those categories, the user can either conduct a full-text search of all the data or he can topically run through the catalogue. The above named main categories are meant to help with the pre-selection and filters. For example, certain online degrees which are organised by recognised universities can be found in the category *"Accredited Higher Ed."* as well as in the more general category *"Courses & Tutorials"*. Apart from the catalogue, the rubric *"Student Services – A wealth of services to make e-Learning more productive and enjoyable"* exists. This is mainly a catalogued list of Internet addresses of other commercial services and information services. The design of the service seems altogether a little confused. Unlike the search engines we examined so far, this design cannot be called minimalist or even user-centred. The site offers the user an abundance of links without explaining what is behind them. (See figure 2) As eLearners.com is a commercial provider, it is not surprising that numerous adverts are placed on its pages. In addition to traditional banner adverts there are links to various online dealers. ELearners.com receives commission by way of partnership agreements when Internet users buy something there.

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[21] http://www.elearners.com/help/faq_general.asp#1
[22] cf. http://www.elearners.com/help/press_room.asp
[23] cf. http://www.elearners.com/help/faq_schools.asp#2

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eLearners.com

| Courses & Tutorials | Degrees & Programs | Accredited Higher Ed. | Training & Continuing Ed. | Student Services | Site Help |

The premier source for information about online & distance learning programs

We'll help you find Online & Distance Learning Courses, Degrees & Training

Find Courses and Online Degrees:

[   ] Go

Type in a subject you want to study online, then hit Go.   Advanced Search

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Thousands of online & distance learning courses

Degrees & Programs:
Undergrad and graduate online degrees, certificates, diplomas

Accredited Higher Ed.:
To display only accredited U.S. Higher Education degrees

Training & Continuing Ed.:
To display only continuing education and non-accredited

Student Services:
Student Loans, News, Vendors New to e-Learning & More...

Site Help:
For Learners, For Providers, General Questions

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site privacy statement

Done

3. The Teoma search engine

3.1 Conception

Like its competitor Google, Teoma.com is a robot-generated index and was the result of a university project. Teoma was developed by a team of computer scientists under Professor Apostolos Gerasoulis at Rutgers University in the year 2000 and launched in April 2001. In September of that year the search engine was sold to AskJeeves, Inc., and in early 2003 a new version was introduced: Teoma 2.0[24]. The name Teoma is Gaelic and means *"expert"*. In programming terms it stands for the search technique Teoma uses, based essentially on the same approach as Google with its page-ranking technique. However, it differs from Google in that whereas Google uses all the documents referred to in order to calculate the page rank, Teoma only uses references from documents whose subjects are closely connected with the hit. Documents with a high number of references to documents with similar subjects are shown as a "resource". This technique is known under Teoma as subject-specific popularity[25]. In addition, Teoma offers a refinement of the search results: keywords with similar subjects are shown next to the list of hits. Choosing a keyword broadens the search by this word. However, the term *"refine"* for this activity is ambiguous: a user who is unaccustomed to Teoma would expect a search within the hits found. Like Google, Teoma is intended for any Internet user. There appears to be no focusing on one particular target group. Unfortunately, Teoma publishes neither concrete information on the index size nor user statistics[26]

Since Teoma's April 2002 launch, it has grown its index by more than 500 percent. With the release of Teoma 2.0, Teoma has crawled more than one billion Web pages and indexed more than 500 million URLs. Index growth will be a primary focus for Teoma moving forward, including a major increase in size due for early spring and summer of 2003.

Outside estimates on the real index size vary enormously, assuming a size of somewhere between 350 million and about 100,000,000 indexed documents. At best, this would mean that the Teoma index was a third of the size of the Google index.

3.2 Characteristics

One of the characteristics of the Teoma search engine is that it is only available in English and under the American .com address. Extended functions are also elusive items. The search possibilities are limited to the World Wide Web. Only HTML documents are indexed. It is not possible to call up cached pages or obtain automatic translation of documents appearing in other languages. Whereas registering new Internet sites is usually free for most search engines and catalogues, Teoma asks for relatively high fees – registering a URL can cost up to $ 30[27].

A positive point is the minimalist design of the search service offered. But there is no denying the influence of Google.com:

On the start page the input field is beneath the relatively large Teoma logo.The search button for starting the search is on the right-hand side. Beneath the input field there is a checkbox that the user can activate if the search words entered are actually a string. Text links lead to enhanced searches and pre-settings. There are some irritating factors, however: on the right-hand side of the input field there are graphics, highlighted in colour, for *"Results – Relevant Web Pages"*, *"Refine – Suggestions to narrow your search"* and *"Resources – Link collections from experts and enthusiasts"* which have no links. At the bottom of the page there are three text links: for registering a URL (requires payment), for an information page on working with the search engine and for a summary of information on the company. The hit-list, too, is clearly designed. At the top of the screen there is a highlighted bar with the Teoma logo, an entry form and the corresponding search button. Text links lead to enhanced searches and to the pre-settings. Above the input field there is a link for search tips, and beneath the field the checkbox previously described. The subsequent page content is divided into three areas. On the left-hand side of the screen the hits are shown, with the number of documents found altogether and the number of hits currently displayed. On the right there is a list of keywords found which may be used to narrow the search. Underneath, the *"Resources"* are shown, documents which indicate numerous sources that may be relevant for the search. The hit itself consists of the title of the document found, as a link, an extract of the description field in the document's metatags and the exact URL name.

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[24] http://sp.teoma.com/docs/teoma/about/developmentteamhistory.html
[25] http://sp.teoma.com/docs/teoma/about/searchwithauthority.html
[26] ibidem
[27] cf. http://ask.ineedhits.com/sitesubmit.asp?id=30270

4. Usability

One object of this work is to check and compare the usability of the above-mentioned search services. First, the term usability must be defined.

4.1 Definition

The term usability is defined in Part 11 of ISO Norm 9241 (Eichinger 2001):

> *The usability of a product is the extent to which it can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.*

4.2 Usability Engineering

The usability of a product is developed in a complex process known as usability engineering (Eichinger 2001):

> *Usability Engineering is a process in the course of which the usability of a product is defined, measured and improved.*

The general aim of usability engineering is to improve the usability of a product by the user. The more concrete aims pursued depend greatly on the type of product and the domain it is used in.
In the case relevant to this work an aim would be to enable users of search services to obtain relevant search results in a minimum of time and with a minimum of effort.

4.3 Usability testing

Measuring the usability of a product requires detailed testing. This is traditionally done by the product manufacturers or specialised service companies in special usability laboratories with comprehensive technical equipment. Using a group of participants from the targeted user group tests are carried out to see if the previously established usability aims are achieved. The users are observed while using the product or Web pages, and the subsequent analysis of their behaviour allows conclusions to be made concerning any existing usability problems. A group of 5 testers will discover as much as 70 per cent of all serious user problems (cf. Harms & Schweibenz 2000).

4.4 Usability inspection

Since traditional usability testing entails relatively high costs and often seems unjustifiable in its cost-benefit ratio, usability inspection methods appear to be a more reasonable alternative[28]

> *Usability inspection is the name for a series of methods by means of which examiners test the usability-relevant aspects of a product. The examiners may be end users, domain experts, software developers or usability engineers.*

The aim of these methods is to identify usability problems,

> *that is, characteristics of a product which could be detrimental to the efficiency or effectiveness of the product-user interaction or to the user's satisfaction.*

It is recommended that a group of 3 to 5 examiners undertake the evaluation. They find 60 to 70 per cent of existing usability problems. However, a single examiner can, depending on his or her experience and professional background, find about 35 per cent of all problems.

4.5 Heuristic evaluation

For this work, the method of heuristic evaluation was chosen to evaluate the user interfaces of the search engines named. This method examines the degree to which the user interfaces comply with certain principles of usability known as heuristics (Harms & Schweibenz 2000).
> *Heuristics are guidelines for the user-friendly design of information systems and are developed on the basis of the empirical knowledge of experts. Heuristics can differ in size and quality, can be domain-specific or general, and can be applied in respect of design or evaluation.*

Although some limitations named above, the author considers heuristic evaluation to be the most suitable approach for the task at hand, since classical usability testing or evaluation based on extensive checklists would surpass the scope of this work. Of course this heuristic evaluation cannot reveal all potential or actually existing usability problems. Nielsen points out that both the testing and inspection methods should be used since each has specific strengths and weaknesses (Nielsen undated):

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[28] http://pcptpp030.psychologie.uni-regensburg.de/student2001/Skripten/Zimmer/u-inspection.html

Since heuristic evaluation and user testing each finds usability problems overlooked by the other method, it is recommended that both methods be used. Because there is no reason to spend resources on evaluating an interface with many known usability problems only to have many of them come up again, it is normally best to use iterative design between uses of the two evaluation methods.

Heuristic evaluation is based on the ten usability heuristics developed by Nielsen and Molich (1990). Since these were developed as early as 1990 for classical software, this work is oriented to the Web-specific adaptations and extensions of these heuristics developed by Keith Instone (1997):

1. Visibility of system status – orientation, navigation and system behaviour
Is the user able to cope? Does he know where he is and what he can do next? Are navigation facilities visible and clear?
2. Match between system and the real world
Is the concept of the Web page comprehensible? What are the target groups? Is the approach appropriate and comprehensible?
3. User control and freedom
Error tolerance: is it possible to reverse usage errors? Are the Web pages compatible with different systems and browsers? Is it possible to adapt the design to the user's requirements?
4. Consistency and standards
Are the terms, headings and graphic elements used consistent? Are design standards and technical standards adhered to?
5. Error prevention
Is the system designed in such a way that misentries can be prevented when using forms and masks?
6. Recognition rather than recall
Is it intuitively possible to use the Web page? Is navigation in the information offered easy? Is the user's current position in the system always indicated?
7. Flexibility and efficiency of use
Are there any accelerators or shortcuts? Is it possible to create bookmarks from the pages? Is the system user-adaptable?
8. Aesthetic and minimalist design
Does the design correspond to the expectations of the target group, is it adapted to them? Is the font size used the right one? Are the contents of the Web pages clearly structured and readily comprehensible? Is all relevant information represented according to its meaning and importance?
9. Help users recognise, diagnose and recover from errors
What do the error reports say? Are they also understandable for less experienced users? Are solutions suggested?
10. Help and documentation
Are help texts offered? How can these be accessed?

5. Heuristic Evaluation: Google.com

1. Visibility of the system status

The user is able to work fast and intuitively with the Google homepage. The search grid is positioned centrally and can clearly be identified as such. The symbolic tabs as metaphors for the choice of the data source are easily understood and have been implemented simply, but effectively. The hit list has also been well designed with regards to the visibility of the system status. The entered search term is highlighted again. The number of found hits as well as the duration of the search are displayed.

22. Adaptation of the system to reality

Google.com as a universal search engine is directed at all internet users. The language of the user interface can be changed. All in all, 88 languages are available. Consequently, even users who are unable to speak English can use the system. If the user is required to take an action, he is explicitly addressed and guided[29]:

> *Save your preferences when finished and return to search*

The multi-coloured logo and the „I'm feeling lucky" button make the search engine seem sympathetic and informal overall.

3. User control and freedom

Wrong entries through typos are supported by the system. Should the incorrect search term be found in the internal dictionary, the correct spelling for the search is suggested. The user interface of the search engine can be correctly reproduced with all web browsers with graphic abilities. Texts can be displayed enlarged or downsized without affecting the artistic consistency. The user is able to influence the system's behaviour. The language of the user interface and the language in which the search is to be conducted can be chosen. The number of displayed hits can also be adapted to the user's preferences. It can also be determined whether the hits should be displayed in a new browser window.

4. Consistency and standards

The minimalistic design corresponds with W3C conventions. User guidance as well as the terms used and the multi-coloured designs are consistent.

5. Error prevention

The reduction to the essential, i.e. giving the user one single search grid, leads to a high level of error prevention. In principal, every search leads to a result. Experienced users can use the advanced search, where significantly more search grids are available. However, the danger of making mistakes also increases significantly if the user does not understand the functions of the separate search grids.

6. Recognition instead of memory

The user interface can be used extremely intuitively. Unexperienced users can immediately use the system without having to learn how to use it. There are no other contents which might distract from the original reason for using the search engine – to search internet contents. Even the adverts appearing next to the hits are in a direct topical context with the search and, accordingly, do not distract or disturb.

7. Flexibility and efficiency

It seems impossible to achieve a faster search result than through the simple search on the home page. The hit lists can be stored as bookmarks without a problem. They can easily be accessed after this. The system can in some respects even adapt to the user through its many options to determine preferences.

8. Aesthetic and minimalist design

The target group of the search engine is extremely heterogeneous and this has to be reflected by the design. Boiling it down to essential and necessary information has successfully developed a functional minimalist design. The information relevant for a search has been clearly highlighted and can clearly be distinguished from information about the company.

9. Error and system messages

Error or system messages a clearly formulated:

> *Your search - qwe232df33 - did not match any documents*
> *No pages were found containing "qwe232df33"*
> *Suggestions:*
>   *- Make sure all words are spelled correctly.*
>   *- Try different keywords.*
>   *- Try more general keywords*
>   *- Also, you can try Google Answers for expert help with your search*

Recommendations as to how to avoid mistakes of this nature and as to what to do next are given.

10. Help and documentation

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[29] http://www.google.com/preferences?hl=en

The page with the advanced search links to a help page, which gives information about the complex search options. In addition, the user can refer to extensive help and documentation sites on which all functions offered by Google are explained in detail.

11. Result
In summing up, one can say that Google.com is a brilliantly designed service with regards to its usability. As already demonstrated, a user-friendly design is an ideal worth pursuing for Google.com. „Focus on the user and all else will follow". This simple approach to use is most certainly not the last reason for the popularity of the search engine.

6. Heuristic Evaluation: eLearners.com

1. Visibility of the system status
The homepage of eLearners.com seems overcrowded and confused at first sight. A relatively large graphic throws light on the website's aim. The user is confronted with a huge number of links, whose functions or rather, whose underlying information, is not recognisable. Access to the various search masks is redundant. You can navigate either via with the help of the symbolic tabs or with the central text links. In addition, there is a small search grid, which can easily be overlooked. There is also the possibility to browse topically. However, the order of the catalogue categories does not match the user's expectations and they are consequently not recognised as such. User guidance has to be regarded as insufficient. It is never apparent which level of the service the user is currently using. An internal navigation with the possibility to move back one page is not available. The tabs give the only orientation point.

2. Adaptation of the system to reality
eLearners.com is aimed at an American audience. The target group is divided into people looking for E-Learning service and institutions providing said services. The aim to offer a directory for E-Learning services is obvious. However, the user already has to know what he is looking for. He has to know the meaning of the various main categories, otherwise he will not achieve adequate results.

3. User control and freedom
The service can be accessed from all common systems and browsers. The font can easily be scaled. However, the service is not adaptable to the individual needs of the user.

4. Consistency and standards
The web site design fits the common HTML standards.

5. Error avoidance
Because of the redundant offer of search possibilities, it is difficult for the user to decide which search mask is the appropriate for his search. Also, the search has to be restricted to either „Degrees" or „Courses". A user who has a limited knowledge of the American E-Learning market is in danger of getting bad or no results.

6. Recognition instead of memory
A spontaneous or intuitive use of the system seems impossible. First of all, the user has to familiarise himself with the information on offer before he can use the site's functions.

7. Flexibility and efficiency
For users who have already gained experience with the system, there is an advanced search with additional options. There is no allowance for a personalisation of the service. Bookmarks of hit lists cannot be added. It is also not possible to create links to certain hits.

8. Aesthetic and minimalist design
The design of the website cannot be regarded as minimalist. (See: Visibility of the system status). Advertising banners – up to two per page – distract from the actual information. The numerous links are confusing and can lead to the user's disorientation. All in all, the service seems visually boring and uninviting.

9. Error and system messages
The error message if no hit is found is easily understandable. It gives instructions as to how to avoid such mistakes[30]:
> *From your search terms it appeared that you were seeking degrees, but we did not find any that contain your terms. Try broadening your search with fewer terms or more general terms. Also check your spelling.*

10. Help and documentation
The offered help does not meet the user's expectations. The „Get Search Help!" link next to the search mask leads to another search mask and a short explanatory text. This leads to confusion instead of help. Under the tab „Site help" there is a long list of FAQs. The user has to search these first before he finds the corresponding help to his problem. In other words, help is delivered independent from context. The user himself has to find the relevant information.

11. Result
The usability of the service can with out a doubt be improved. The design of the web pages has to be clearer and more friendly. Attention should be paid to functional user guidance. A decrease of access to information should be taken into consideration. Information, which is irrelevant to the actual search, should be shown less prominently. Help has to depend on context.

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[30] http://www.elearners.com/search/search_help.asp?help=D3

7. Heuristic evaluation: Teoma.com

1. Visibility of the system status
The start page of the Teoma.com search engine is relatively clearly structured. The search field is immediately noticeable and identifiable. Instead of the customary HTML button there is a graphic search button. One irritating point is that a user who is not used to Teoma could assume that the three coloured points *"Results", "Refine"* and *"Suggestions"* have links - but these graphics have no links. Another irritating factor for the unpractised user is the "find this phrase" checkbox beneath the input field, since the function of this box is not intuitively clear. The results page is also clearly structured. The number of hits found and of those displayed are given. However, it is not intuitively recognisable how to use the "Refine" and "Resources" options on the right-hand side of the hitlist; the user has to find out beforehand about the influence these options have on the search result.

2. Match between the system and the real world
Teoma.com, too, claims to be a universal search engine with no specific target group. But the user interface is only available in English, which therefore only makes the search engine of any use to users who speak that language. The user guidance needs improvement. On the *"Preferences"* page the system gives no indication at all of what the user must do to change pre-settings and to save data.

3. User control and freedom
The system catches misentries caused by wrongly spelt search words: if the faulty search word produces only a few hits then the correct spelling for the search is suggested. The search engine's user interface can be correctly reproduced with any Web browser with graphics capabilities. Texts can be presented in enlarged or reduced format with no detriment to the design. To a slight degree the user can influence the system behaviour. The number of hits to be displayed can be adapted to the user's preferences, and it is also possible to change the display setting so that the hits are opened in a new browser window.

4. Consistency and standards
The design fulfils the HTML conventions of the W3C. The user guidance and use of terms and colourful design elements are consistent.

5. Error prevention
Assuming that bad hits or no hits are considered as errors, there is a relatively low risk of generating errors in the basic search since any meaningful entry there leads to a result. In the enhanced search, however, using search fields whose meanings or functions are unclear can lead to a higher incidence of errors.

6. Recognition rather than recall
Starting a basic search is unproblematic even for an unpractised user. But interpreting the results page is not intuitively possible. And without previous information the user cannot clearly see how to use the *"Refine"* and *"Resources"* options (cf. Visibility of system status).

7. Flexibility and efficiency of use
Creating bookmarks from hit pages is unproblematic. There are some (not many) cases where preference settings can be changed to suit the user's needs. If the aforementioned *"Refine"* and *"Resources"* options are used correctly, a search can actually be made more efficient.

8. Aesthetic and minimalist design
The design of the user interface can be described as aesthetic and minimalist. The information relevant for a search is clearly marked. There are no further contents to distract the user from the search or the results. All in all, the search engine appears attractive and friendly.

9. Error reports, system messages
Error reports and system messages are clearly formulated:

> *We found no matches for your search qwe232df33*
> *Please try again.*
> *Some suggestions are:*
> - *Check your spelling.*
> - *Try new keywords or more general keywords*

Suggestions are made as to how this type of error may be avoided and what to do next.

10. Help and documentation
The help pages and documentation pages offered by Teoma are few and far between. Two different versions of *"Search tips"* are offered. The information offered is aimed at experienced search engine users rather than novices.

11. Result
By and large, the Teoma search engine is *"usable"*. There seem to be no serious usability problems, although a number of functions are not self-explanatory. The user is presumed to be relatively experienced. The homepage could be more clearly arranged.

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