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Getting Information on the WWW for Educational Purposes: Problems and a Possible Solution

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Abstract

One of the great advantages of the World Wide Web (WWW) is the enormous amount of information it makes available. Nevertheless, URL (Universal Resource Locator) addresses obtained from search engines often have little to do with what users are actually interested in finding. This proves especially problematic when one is searching for educational material. In order to improve on this situation we have designed a search engine that specialises in managing content previously selected from the Internet. The search engine is compatible with both keywords and keyphrases.

Keywords

Cooperative/collaborative learning, interactive learning environments, navigation, pedagogical issues.

1. Introduction

Over the course of the last few years the Internet, and in particular the WWW, has increased dramatically in popularity. A significant proportion of European and American households currently have access to Internet at home. This was not the case just two or three years ago. While the number of people who periodically visit the Internet has increased

substantially, a similar increase has also been seen in the number of personal computers connected to the WWW offering either online services or simply information of some kind.

The rise of the WWW has also been felt in the field of education. Most higher education institutions have their own webpages in which, besides giving information about the courses offered at their schools, they complement their offerings with other, more dynamic, services. These may include a constantly updated table of events, access to online services (in some cases students can even enrol online), access to university intranets (in which one can find, through password access, a great variety of educational material), links to other webpages that may include discussion forums focussing on academic or non-academic themes, and engines for searching through listings of academic and staff services.[i]

The way in which information (or the thematic headings under which information has been classified) is organised and presented to the user varies slightly from one site to another. Some of these sites are maintained by public institutions of international prestige, and as such they are under their control and subject to their credibility (Chen, 1993). Others are maintained by individuals who, with great enthusiasm at the beginning, start databases of URLs they find interesting, and eventually achieve popularity over time thanks to their tenacity and ability to make people notice their webpage. Logically, one also finds some websites supported by private institutions that to some extent use the services they offer for free to advertise their products. These websites are the ones most often found on the WWW, and some of them even take advantage of the ingenuity of the user to obtain information for commercial purposes.

2. Finding information on the www

2.1 General aspects

One of the real successes of the WWW has been the enormous amount of information it has made available [ii](Note 3). However, the very existence of this information can present a serious problem to the user. One of the dangers one may encounter (if one is not familiar with the online environment) is the possibility of getting lost and subsequently being disoriented on the Internet. Ultimately, one fails to find the information being sought. On many occasions — too many — the sites one is directed to after performing a search bear little resemblance to what one was interested in finding. This situation proves especially problematic when the user is a student. What educators must do when suggesting that students take part in activities using the Internet is to ensure that this does not result in tedious work or that the student "wastes time" visiting unsuitable or incorrect sites (Web Search Library), (Heller, 1990), (Marchionini, 1995).

When students realise the enormous potential the WWW has to offer for finding information on any subject, they often connect to the Internet and try to find relevant facts or information on a particular topic. Generally speaking, the non-expert user often accesses either sites in which the information offered is organised thematically, or sites specialised in producing URLs around a specific theme or subject. There are many sites that can serve as stepping stones for fruitful searches, yet in most cases the users returns to favourites they have used previously, knowing that there they have a better chance of finding usable information.

Something that must be kept in mind in order to achieve a better use of search engines is how they actually locate the results of their searches. Many search engines have “bots” that visit WWW servers every few hours and compile a database by keeping records of the information described on each webpage. This method, however, is clearly flawed: the database description of the webpage may not be entirely pertinent to the actual content of the webpage. If the search engine classifies webpages by title, for example, this runs the risk of not properly describing the webpage’s content.

To give an example of the shortcomings of search engines, consider this hypothetical scenario: imagine a student wants to find information about the solar system for an assignment. If he or she connects to a global search engine and types in the word "sun", the search results will produce a list of links, beginning with the homepage of a well-known software company. Is this by chance, or is there some mechanism that causes it to appear first? Ethical considerations aside, the truth of the matter is that the students will be disappointed about what the WWW has to offer in the way of information useful for their astronomy assignment.

One way to avoid this problem is to use the advanced search tools offered by search engines. Suppose that one wants to know how to make turtle soup and enters the query "turtle soup". Invariably, the results will provide enough information to make a good soup, but it would have been easier to find better results using the query "turtle soup recipe". In other words, if one takes advantage of advanced search tools the corresponding results will be more along the lines of one’s expectations.

2.2 Information for educational purposes

Drawing an example from an educational context, assume one must find information on the Faraday law. The user will potentially find numerous sites, but in how much depth does each webpage explore the subject? At university level? At elementary level? Furthermore, does it simply explain the law or are there complementary examples? Does it provide theoretical information or does it detail specific situations in which Faraday’s law has had to be used? Also, in what language is the page written? Is it a personal webpage or is it supported by an educational institution? Many such questions must be posed before one finds the right webpages using this kind of a search. If one is required to visit each of the 104,000 hits given by a search engine, one will surely give up, frustrated, before coming across a suitable one. Another example: suppose one has to find information about Magnetic Induction, and introduces the word "induction". Here, one gets 689,000 hits. By writing "magnetic induction", the results are narrowed down to 52,000 relevant pages. To determine which webpages explain this subject at a secondary school level, one could also add the word "secondary" to the searching text. The results, however (19,500 sites) are very misleading because the word "secondary" appears in the phrases "secondary coil" or "secondary voltage", but none of these webpages actually states whether its content is in fact designed for secondary students. Something similar occurs if one adds other words that promise to make the search more specific; the system simply does not produce the expected results.

What, then, can be useful about thousands of webpages dealing with the same subject? Generally speaking, suggesting the possibility of navigating through thousands of sites on the WWW to a student does not spark much interest. Unless one knows before starting how to link the words in any given query, one can end up searching endlessly through the WWW. Offering copious information is not synonymous with offering quality. One method to avoid this is to select webpages prior to the searching process, thus removing those that are less interesting.

Another issue that teachers must take into account when asking students to use the WWW to find information is the variable quality of the webpages they might visit (Chu, 1999) and (Ko, 2001). The Internet is open to all sorts of users; anybody can post his or her webpage without much difficulty, and obviously these webpages can be called up on any browser. The problem students may encounter is that the information they find does not always keep to the point of view and established opinions of the scientific community, meaning that the user could easily find false, poorly-explained or unsuitable information. This does not occur with standard bibliographical consultations in which, if only due to the complex and slow editorial process, the reader has a better idea of the credibility of its content. Readers know whether the author belongs to a recognised institution or not. In the same way that educators recommend references they know and trust, and on which they can deliver an opinion, they must be also be familiar with the specific websites they recommend to their students, whether directly or through another person's recommendation.

3. Types of search engines

3.1 Global search engines

The most common search engines are global ones (Tabke, 1999). Most webpages of the WWW are indexed in them. In its simplest form, from the users' point of view, a global search engine is nothing but a webpage with an input field—generally in plain text format—and a method, generally a button, for starting the search. The users enter one or more words of text into the input field describing the information they wish to search for. In general, users can combine different words using the Boolean operators AND and OR, which allow them to more accurately orientate their searches. The browser then translates the text that the user has introduced in the "command" field and sends the request to the server, which then processes the information, returning a list of links to webpages that contain the words sent in the request.

The server's database can be constructed in several ways: occasionally it is the work of the webpage authors themselves, who by sending their webpages (or their URLs) to the most important search engines ensure that they appear on these lists. In other cases, the information used to construct the database is gathered by "bots" that compile lists after examining the information contained on WWW servers.

It is important to note that HTML (Hypertext Markup Language) allows webpages to include META fields so that their authors can insert either "keywords" to describe the webpage or a series of words they want to use as a way for it to be found.

The first global search engine appeared in 1994 with the University of Washington's development of the *Webcrawler* ® search engine. In June of that year, *Lycos* ® developed at Carnegie Mellon University, made its appearance. Later that same summer, *Yahoo* ® made its debut, and went on to become a major player on the Internet. From that point forward, the number of WWW search engines has increased extraordinarily due to their high profitability. They are webpages visited by thousands of users every day, and as such they represent the perfect place for commercial enterprises to advertise their products and services.

Nevertheless, the equipment a global search engine requires to be able to cope with this volume of information and to deal with the high number of requests is only within the reach of businesses that can afford a major investment.

3.2 A Local search engine

The local search engine's objectives are typically more humble than those of a global search engine, because it deals with a known volume of information and tends not to be updated too frequently. Such a search engine becomes necessary in servers as the number of documents they contain increases.

Several commercial tools, such as *Netscape Compass Server 3.0* ® or Microsoft's *Index Server 2.0* ®, allow webpage servers to add this function to their pages. These tools work similarly to search engines, but are restricted to the domain of the server. In order to function, the search process requires an index of all documents contained on the server, which is periodically updated.

Requests are generally initiated on a webpage, whose fields allow the users to enter the terms of their query, define the characteristics of the search and clicking on a button to start the search. When the search order is sent, the server receives the query, processes the request and returns a list of documents from its local index. This last operation is in most cases performed using the CGI process (Common Gateway Interface).

One of the major problems common to both global and local search engines is that the information they keep is thematically catalogued. This, which would seem to make the search for information easier, instead presents the user on numerous occasions with added difficulty and annoyance. Thematic classification can often result in tedious searching, as search engines do not necessarily classify material in the same way as the users do. Classification criteria are not unique, and the presentation of the different possible epigraphs is dependent on them. Therefore, the time required to find something that is related to the searched item is too long

4. An educational search engine

In order to solve some of these problems, one group has designed and constructed an information manager to complement the function of the classic search engine (Blanco, 2000). The main objective of this is to guarantee that the information students find when using a

search engine is both relevant and suitable for an educational context. Its principal features are described below.

a- *Material is not classified automatically, but rather selected by a specialist (in most cases, an educator). Thus human intervention is present in the selection of the material offered by the search engine.*

We have already mentioned that an educational search engine must produce a list of links to webpages that are relevant to the subject the student is researching.

The prior selection of the webpages allows the right educational criteria to be applied in order to offer chosen webpages related to a specific demand. Thanks to the search engine's possibilities for configuration, one can select the information that will appear based on the students' level (or any other criterion); students at different levels require webpages of different registers. One can similarly address many other specific concerns, such as the language in which the webpage is written.

Material is catalogued by examining the real content of each webpage. Once all the URLs to be included in a database have been determined, these are catalogued by examining exclusively the real content of each webpage. This means that it is necessary to visit each webpage being catalogued and assign to it a group of keywords to identify its content. One can often find search engines on the WWW that visit and automatically classify webpages. The criteria that they use to catalogue webpages are generally based on the number of repetitions of specific words in the text. These criteria can be very useful for specific types of information, as in the case of commercial webpages related to product catalogues, but they are not suitable for webpages with a cultural or educational content.

b- *The search language is not decisive in the search process*

Student users of the Internet are also often interested in searching for webpages broaching certain topics, but without restricting their search to information in any one language. By and large, as most search engines are restricted to searches in only one language, this problem has yet to be solved. Some search engines have the option of searching in different languages but this is done using a different procedure — the search is first performed in a certain language and then repeated using another. Nevertheless, the information gathered from the two procedures is not combined. It seems that in an educational search engine the language should be neither a determinant nor an excluding factor. A student who searches for information on the Faraday law may not care whether it is in Spanish, Catalan or English.

Still, in the case of primary school students the search engine allows the searches to be restricted to just one language. Therefore, at some point in the cataloguing process, one must mention, using the corresponding keywords, the language in which each webpage presents its information.

c- Material is catalogued by keywords and keyphrases.

The use of keywords, though not new, is effective; many search engines use this system. However, it does have the problem of being poorly structured, and if one wishes to classify webpages by their level of detail it requires the use of an extended number of words. This generally proves excessive when one is trying to make the cataloguing process both useful and operational. For this reason, in order to expand the classification method , the *keyphrase* was introduced.

A keyphrase is the combination of two or more keywords. For example, [law, newton] is an example of a keyphrase built up of the keywords "law" and "newton ". Other examples of keyphrases are [law, Coulomb], [unit, Newton], etc. By using these parameters one can resolve matters of uncertainty. For example, if users seek information on Newton's law, they would probably introduce the word "Newton" in the search engine's dialogue box, thinking that the word "law" would be too general. Obviously, then, the search engine will find webpages containing the word "newton", that is, not only those that make reference to Newton's law, but also those that refer to the unit of force in the International System of Units (as it were, the *newton*), those that discuss Newton's rings (an optical interference phenomenon), and any webpage in which the word "newton" appears. This is something that can be avoided to some degree by using Boolean operators (AND, OR,), though in this case what the user really needs is a greater role in being able to determine which results will be produced, and Boolean logic cannot guarantee a successful search. When introducing "energy AND potential", one may arbitrarily assume that the information produced will deal exclusively with gravitational potential energy, webpages on electromagnetism (electrostatic potential energy) or even elasticity (elastic potential energy).

Using keywords and keyphrases, users can ensure that the system automatically associates a given set of words with others, thus forming a sentence. Clearly, the responsibility of defining keywords or keyphrases will fall on the shoulders of the educators involved in the website cataloguing process, who must ensure that all potential keywords enter the catalogue to guarantee a minimum degree of usefulness in the search process.

d- The search engine guides the student throughout the search process.

Occasionally, users may not know exactly which word or group of words are necessary to make their searches useful; the search engine must serve as a guide, suggesting ways and words to increase its functionality. In doing so, the search engine can also serve as an educational tool: by searching for information one can also learn something about the subject of the request.

This is another of the innovative features of the search engine we have designed, particularly in comparison with other search engines on the WWW. The premise that the user need not be an expert on search engines steered the search engine design process. It was realised that most of its users would be students who were expert neither in information

technology nor in the topic at hand. As such, they would not know prior to any given search which keyword(s) would need to be introduced in the dialogue box in order to achieve good search results. To circumvent this process, they can then use the keyphrase.

In order to better explain the design process and point out the differences between our search engine and a conventional one, let us reconsider the previously cited example: suppose a student wants to find information on Faraday's Law of Electromagnetic Induction. Inevitably, the student will not know exactly which words to enter. Imagine that he or she tries the word "faraday". The results a conventional search engine would produce would be extremely divergent, as there are many documents that contain the term "faraday". Indeed, there is no guarantee that the webpages obtained as a result of the search even have anything to do with Faraday's Law. Some of them may describe Faraday's life and yet others will explain what a capacitor is and what unit it uses to measure. In our search engine, upon receiving the query "faraday", the system itself suggests that the student use phrases containing the word "faraday" to obtain either [faraday, unit], [faraday, law, induction], [faraday, law, electrolysis] or [faraday, biography]. As the system automatically suggests a phrase, the students are able to choose the word combination that best meets the needs of their search, and in doing so, the search is refined and the results meet their expectations. All of the webpages found in this search will contain specific information on the topic in question, rather than information on other topics concerning Faraday.

In this way, an effective selection of content is made before webpages are found. Supposing though that the user does not follow these steps, he or she must instead very patiently search through every webpage relating to Faraday without knowing in advance whether it deals with electrolysis or Faraday's life.

It should be emphasised that in addition to the advantages it presents in terms of quality and the aptness of any given search, a search engine based on this system never produces null results. That is, something will always be produced as a result of the search, as keywords and keyphrases are read from a file that relates webpages to keywords and keyphrases. If a word or phrase is not on file, it will not be suggested.

Therefore, this search engine has a clear informational and educational value as students are able to learn something in addition to finding the information they look for.

e- Search results provide complementary information on the content of the selected document

The search process concludes by showing the users a list of sites in which they can find information relevant to their query. Because the webpages are selected and classified by educators, the information the instructor finds most relevant is so indicated and these results are shown on the screen.

Any search for information on a given subject will produce a list of results which, besides showing the corresponding URL of the page, make comments about the content and main characteristics of each one: whether the webpages are designed by university institutions or commercial enterprises, the language the information is presented in, specific comments giving the opinion of the person responsible for the selection of the webpage (for example: "...webpage very suitable for third year students"), and any other information considered suitable for a good description of the site. To make the system quicker and more user-friendly it is recommended not to seek too much information: a few terms will suffice, and with use and experience users will quickly be able to make correct decisions each time.

f- The search process is performed offline

One of the most common problems one encounters when using search engines on the WWW is the long waiting time as the engine connects to its server. This is discouraging for the user and also represents a significant economic loss. For a quicker reply to a search, the entire search process can be done on the client's computer, so that searches can even be performed offline. Our search engine is programmed in Java script so that when clients first gain access to it, the database generated by the system is uploaded to their PC. By using the corresponding applet (a small Java program that can be embedded within HTML pages and downloaded and executed by a web browser), one can access this database to perform the first and subsequent searches on one's own computer without having to connect to an online server. Access to the database and finding results is thus substantially faster.

Downloading time for the database is fairly short; a file with 1000 URLs is only slightly larger than 50 kb. If the database increases in size, it will automatically separate into smaller files for downloading.

5. Two examples of configuration of the search engine

Our search engine is easily configurable to meet specific needs and to seek specific information. To test the effectiveness of the search engine and the information manager, they were configured for two different situations, first for use as a tool on educational websites, and secondly for use on a browsable CD-ROM.

5.1 La Baldufa: a physics content search engine

We used one of these configurations for the search engine in the *La Baldufa* project (Bohigas, 1998), (Bohigas, 2000), (Novell, 2000). The aim of this project was to use the Internet as an educational resource, and in particular to study what the WWW can offer in the way of improving the processes of teaching and learning physics at secondary school and university level.

The search engine can be accessed through an HTML webpage, which contains the links to an applet that controls and performs the search operations. Three different areas were discernible in the search engine interface.

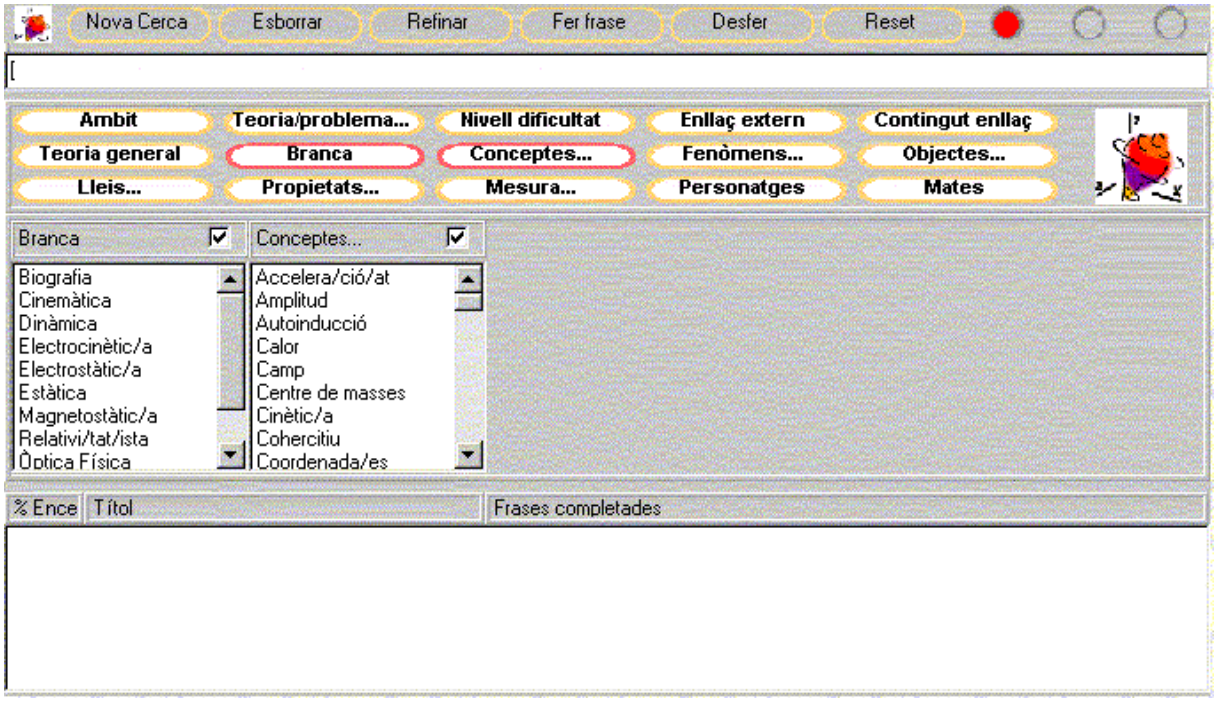

Figure 1.

The search engine interface, showing its many options for selection, as it was configured to be used as a teaching aid on the website http://baldufa.upc.es. The project's objective here was to use the Internet as a resource for teaching and learning Physics. The visible rolling lists that appear when one starts the search procedure are configurable.

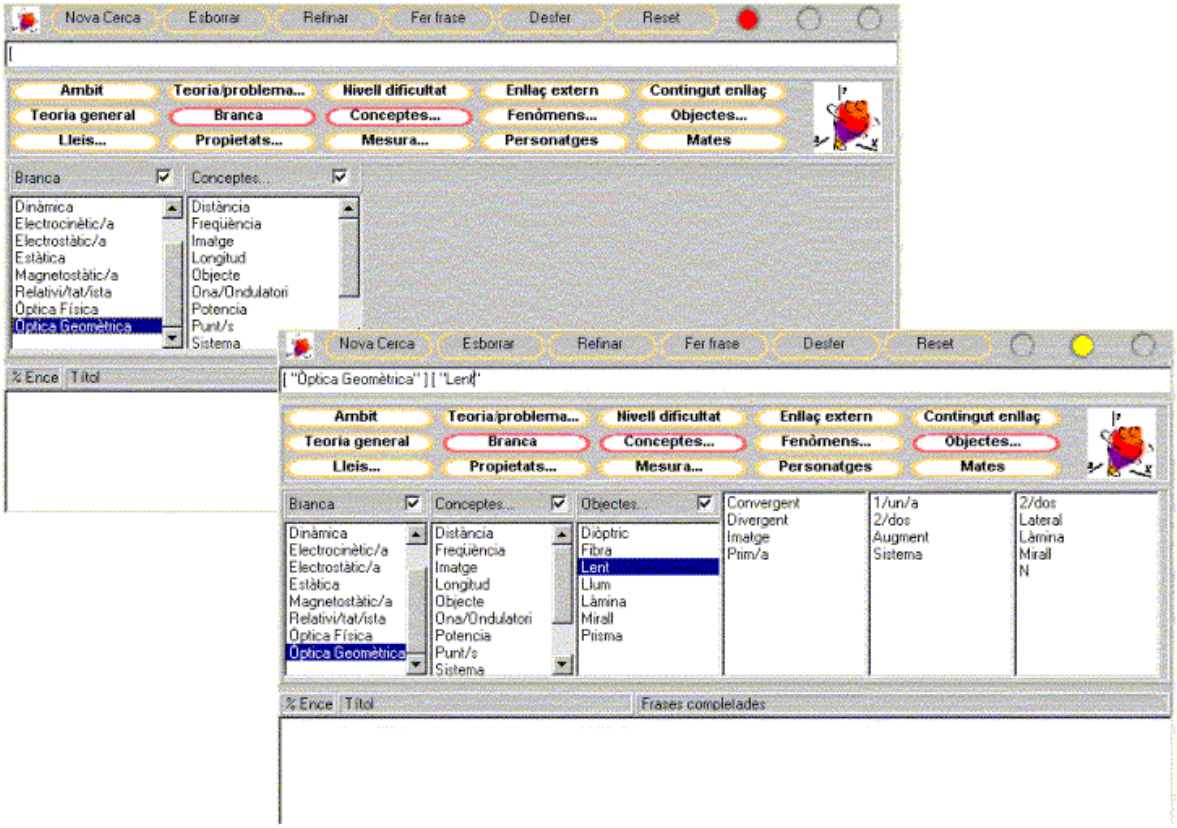

Figure 2.

The student wants to look for information on the topic of "geometric optics"; they therefore enter this term and in the "Concepts" window, only those terms related to optics appear. On clicking twice, the selected word pops up in the dialogue box. To further specify the search for information on lenses the student clicks on the word "lens" in the "Objects" window. Immediately, three windows open, containing different words that complete the phrase with the word "lens". One can therefore complete the sentence by selecting "converging lens" or "lens image two", which refers to the image of an object through two lenses.

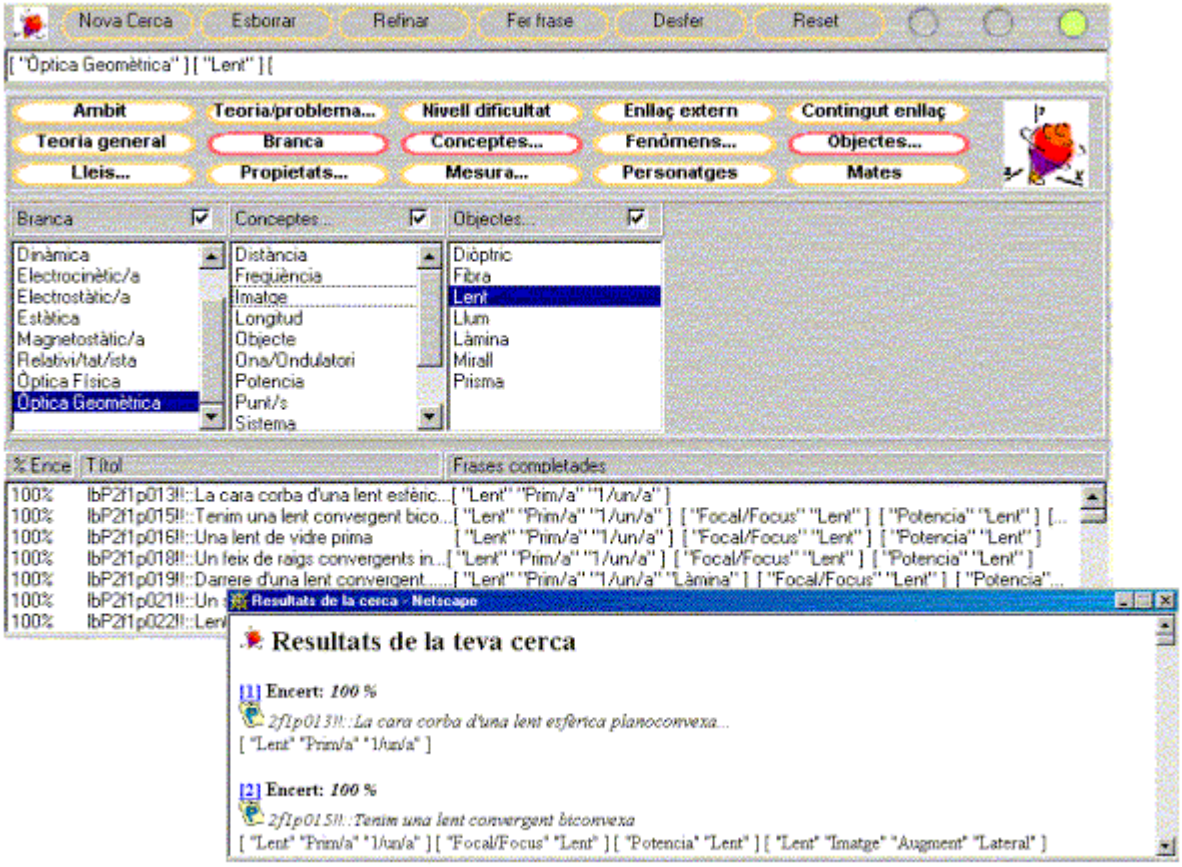

Figure 3.

The student has chosen not to complete the phrase and makes the search with only the word "lens". The result of the search appears in the box at the bottom. In the second column, in addition to the title of each webpage, a small comment is made about its content. In the last column a keyphrase appears which includes the word introduced in the search. These two columns help the students to choose the webpages that most interest them. The result of the search can also be opened on a new webpage.

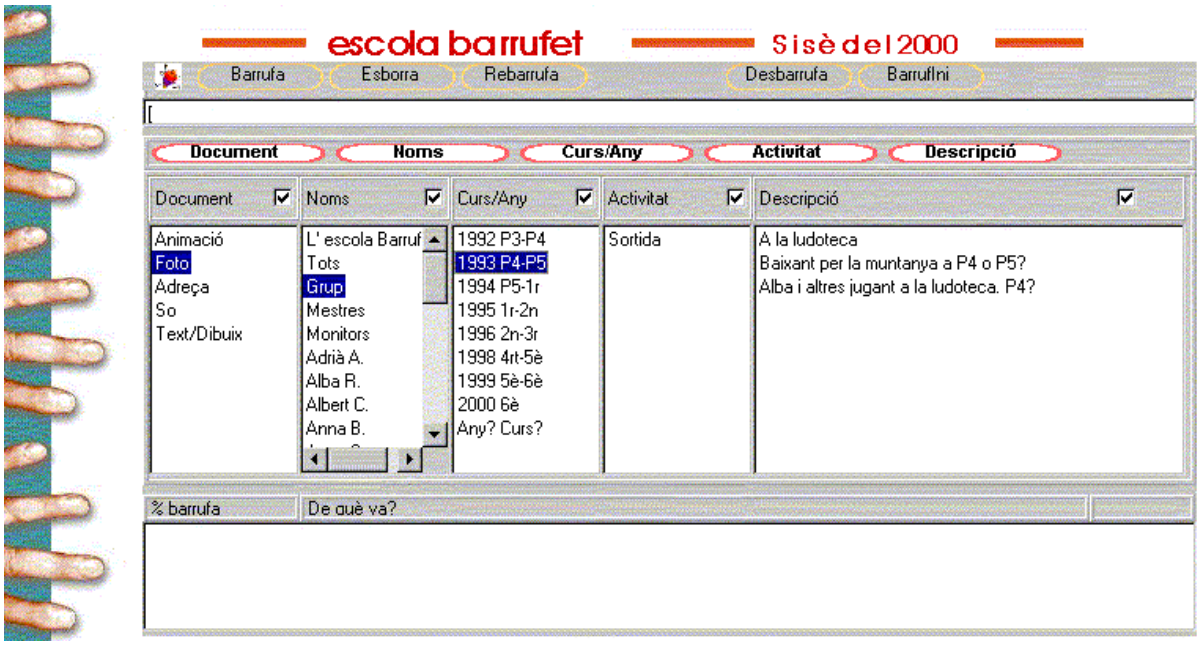

Figure 4.

A simplified version of the search engine, in which the selection options have been reduced. This search engine, using this configuration, was incorporated in a CD-ROM containing diverse information and has been used by ten-year-old children. A child has selected the words "photo", "group" and "1993", upon which the information agent indicates to them that there are three documents corresponding to photographs of groups of students from the year 1993. One of these is a photograph taken on the group's educational outing (first document), the second is a photograph in which one sees the group hiking down a mountain,) and the third is a photograph showing a schoolgirl named Alba playing with other friends. Similarly, one could look for the text written by Albert C. during a particular course, etc.

The first area (from top to bottom) is made up of several buttons, as often seen in search engines, ("new search", "erase" and "refine"), in addition to a button that indicates when a sentence is complete as well as offering advice on how to complete a given sentence. Although the users can intervene directly (by typing their query into the corresponding window), this option is not recommended for this search engine, as differences could arise in the spelling of words or the syntax of the keyphrase, either as introduced by the user or as interpreted by the program. It is seen as preferable to use the buttons designed specifically to enhance the search's potential. In addition, using the buttons allows the search to be guided, and is therefore more effective.

The second area is made up of a group of buttons with rolling lists. Each document is related to a classification and document selection criterion. For example, by clicking on the "people" button one can see the categorised names of physicists; in the "properties" section one can find the words "conductor", "ferromagnetic", "elastic", etc. Each word in each section links to a file that had previously been defined and assigned a hierarchy, allowing the student to become better orientated to the search process. The keywords contained in each section can be seen in the area under the buttons as the user clicks on them. Clicking twice on a word

automatically incorporates it into the dialogue box, and the users can introduce multiple words to begin a search. As the rolling lists only incorporate words that are found in at least one document, the system guarantees that at least one document labelled with the keywords introduced is found.

If the users introduce a word that could be construed as a sentence, the system informs them and tells them which sentences they could then construct from it, thus guiding the search process. For example, suppose that the user wants to find information on Newton's law, but is not sure whether to enter the word "law", "theorem", or "principle". When the word "Newton" is entered the search engine automatically suggests to the user that the word "law" completes a sentence, as do "ring", "unit" or biography", for example. By entering this query in the search field, the user finds a list of webpages with information on Newton's law, thus avoiding the typical problem of not finding the information desired because of inconsistencies in the description of the search term. To give another example, when the word "energy" is entered in the search field the system suggests different options to complete the sentence: "potential", "mechanics", etc. When the word "potential" is selected, further options become available: "gravitational", "electrostatic". Student users will thus also realise that these different forms of potential energy exist. It is important for the student to realise the wider sense of these concepts and how generic simple terms can be. Thus, the search engine actively helps students to learn aspects of both online research and whatever topic they are researching. Finally, the third area of the search engine interface displays the results of the search, showing both the title of each webpage retrieved and the keywords used to classify the document. One also has the option of opening this list on a separate webpage, with the added advantage that this can then be saved as an HTML file on the user's hard drive for ready access to these sites.

We distinguish between two types of keywords that correspond to two different buttons on the user interface: keywords termed "exclusive" and those that are not. The former have the characteristics of a filter role. The difference is that when the user selects a word from the exclusive category, only documents that contain the selected keyword will appear in the search results. This presents the additional advantage that any words suggested by the program (and also those words suggested to complete a sentence) are properly filtered. Therefore, if the result field "difficulty" is configured to be exclusive by selecting the word "secondary" to narrow down the search, all the documents obtained by the search will be at a level of difficulty corresponding to secondary school.

As mentioned above, the search engine operates on an HTML webpage with an embedded link to an *applet* that controls its functions. The search engine can therefore be easily incorporated into any other webpage. In order to allow educators to incorporate the search engine in their websites, the search engine interface was designed to be configurable so that it would be easily adaptable to the desires of the user. One can add or remove buttons, make categories exclusive, change the appearance of the different parts, etc. The files, which contain the whole set of keywords, as well as their hierarchy, are also easily configurable; words can be added to or removed from these files on a word processor. Another configuration file contains the URLs (along with the keywords that describe them), along with the comments of the educator who recommended each site. This file, as well, is easily modified on any word processor.

5.2 Barrufet School

Picture 2 shows a configured version of the search engine in simplified form. This version, on a browsable CD-ROM, was intended for sixth grade primary school students. The material on the CD basically consisted of a large number of images, documents in text format, sounds and animation files. Nevertheless, the difficulty of presenting the material in a coherent form suggested the idea of making the search engine a tool that users could adapt to their needs. The search engine also had to be easy to operate, bearing in mind the users it had been designed for (ten-year-old children). For precisely this reason the number of buttons and rolling lists was reduced to five. The configuration files were also constructed so that the search would produce results 100% of the time, i.e. the students would always find a document. The search guiding system described above is very useful in achieving this.

From the first rolling list the children must select the kind of document they are looking for —an animation, photograph, sound, text or image file. When they click on the type of document they want, the next rolling list automatically opens, producing a list of webpage hits that allows the user to personalise the search. The system works successively opening more windows to narrow the search, except for the last window, which gives a brief description of the document selected. The search can be initiated from any open rolling list. By double-clicking, one can drop selected text from the clipboard to the dialogue box of the search engine. Clicking the corresponding button initiates the search, producing a list of documents that can then be accessed by clicking on their titles.

6. Conclusion

The sharp increase in the amount of information available on the WWW poses a new problem: how can the thousands of URLs produced by web searches be dealt with, selected or classified? It seems that information which represented a limited advantage just ten years ago is now making things more complicated.

The vast amount of information available on the WWW tends to provide users with very frustrating results unless they are previously aware of particular useful sites, or have a good list of selected sites. In dealing with this situation each user has to develop their own strategies and skills to surf through the large amount of URLs that search engines offer.

When the Internet and WWW are used as an educational resource, this excess of information can often completely disrupt the learning process. To overcome this problem some standardisation processes have been initiated involving the use of metadata for education (Duval, 2001) to facilitate searching, evaluation, sharing and the exchange of learning materials by learners or instructors.

The search engine presented in this paper has the same objective. Where it differs from other standardisation processes is that whereas they are large-scale developments and attempt to manage a large amount of educational objects, the search engine presented here aims to serve at a more local level, closer to specific topics, by cataloguing information selected previously by individual educators. It works with keywords and keyphrases. The idea of a keyphrase has proved to be of great value as a searching tool, especially in the field of

education. As the search progresses the search engine suggests pertinent keyphrases to the user, thus turning the search process into a learning activity.

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