A Web-based interactive training for the self-acquisition of information retrieval skills targeting the PBL students

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OBJECTIVE: To provide the medical students involved in Problem-Based Learning (PBL) with a remotely accessible training tool for the self acquisition of information retrieval skills.

CONTENT: Access to the training tool is made trough a portal Web site. The tool is initiated with a clinical case. A selection of relevant electronic resources such as dictionaries, encyclopaedias, textbooks, and bibliographical databases is proposed. Each resource comes with search examples achieved by librarians concerning the subject of the clinical case. Each step of the strategy is described, commented and illustrated with a screen copy of the original resource. To reinforce the realism, users are invited to click on the appropriate areas of the screen copy to progress in the search. A catalogue is created with the documents retrieved from the different resources. The catalogue is searchable independently and provides links to full-text when available.

The technical support for the training tool consists of a set of related databases (FileMaker Pro, FileMaker Inc., USA). Data concerning the clinical case, including medical imaging, is contained in a first database. Description of – and links to resources are collected in a second database as well as basic user instructions. For every search example in a specific resource, a database is created from a template, containing all the searched terms and screen copies necessary to provide an interactive demonstration. The catalogue of documents constitutes the last database.

The prototype must now be presented to teachers and students and evaluated for quality, performance and user-friendliness. Results will help us to improve the design and content of the training tool.

Introduction

In the year 2001, the Medical Faculty of the University of Liege (Belgium) turned to a new teaching method related to the Problem-Based Learning (PBL) methodology. PBL is a student-centred, problem-based, small group learning approach initiated at the McMaster Medical School (Hamilton, Canada) in the late sixties [1,2]. Typically, the problem is solved in three phases. During the first phase, students discover the problem. They have to clarify terms and concepts, define and analyse the problem, and formulate hypotheses. Learning objectives are defined for the next session. During the second phase, group members individually collect information with respect to the learning objectives. At the third phase, students meet again and share their findings. The newly acquired information is synthesised and tested. [3].

Information-seeking skills are thus fundamental for the success of a PBL curriculum, but also for lifelong learning, a key qualification for tomorrow's physicians [4-6].

For many years, medical libraries have

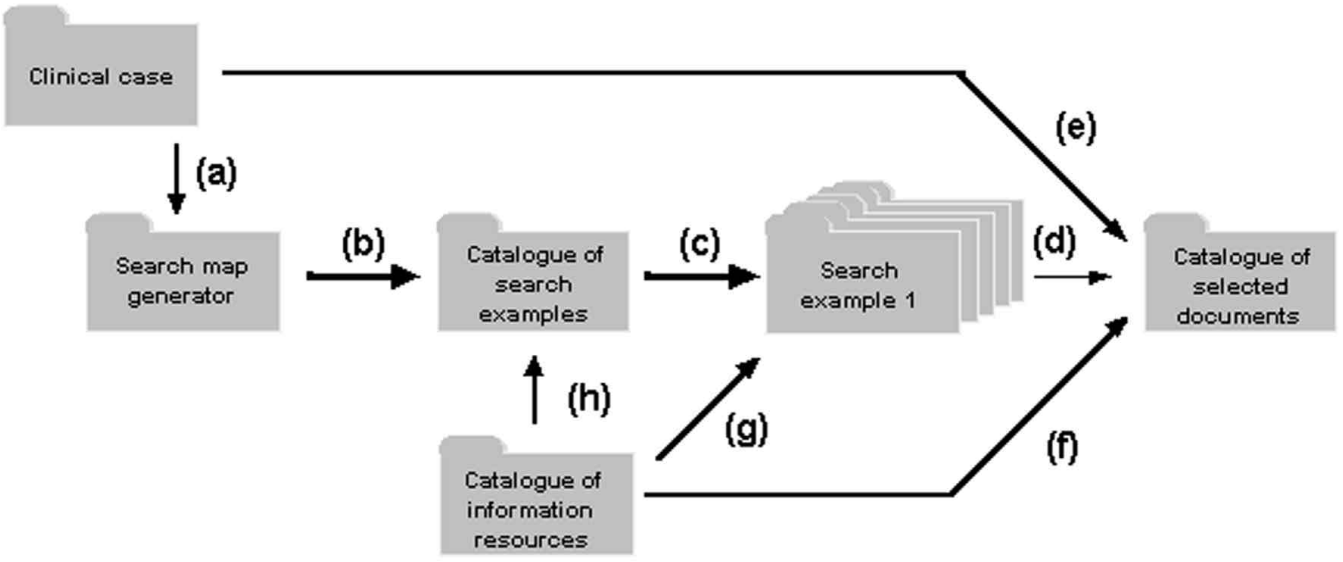

Figure 1: Tool structure

Each object represents one database created with FileMaker Pro. The databases are linked in order to provide the interactive tool. Links between databases are identified by letters (a to h). The "Clinical case" contains all the necessary information, from the patient's main complaint to the diagnosis. The "Search map generator" contains information to construct the search map. The "Catalogue of search examples" lists all the available searches. Each "Search example" concerns a theme and is conducted in one resource with several keywords. The "Catalogue of selected documents" lists pertinent documents concerning the subject of the clinical case. The "Catalogue of information resources" provides a brief description of- and links to selected information resources.

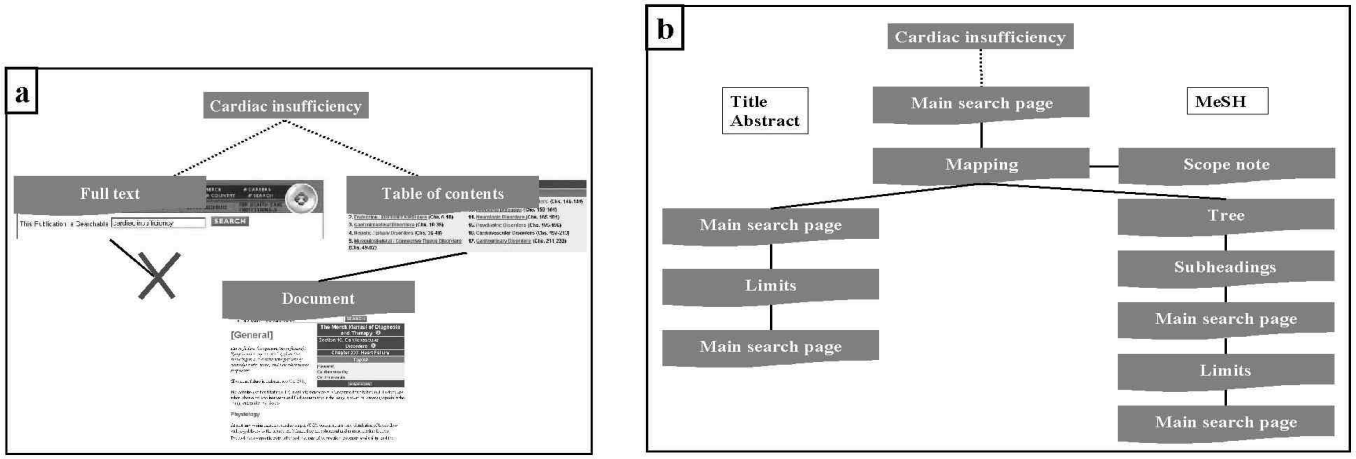

Figure 2: Search scenarios

Depending on the resource, search scenarios can be simplistic or more complicated.
(a) the keyword "cardiac insufficiency" searched in the Merck Manuel of Diagnosis and Therapy
(b) the same keyword searched in Medline OVID

provided students and faculty with training at various times during their curriculum. These training generally concern the library organisation, the literature searching and the critical appraisal of medical literature [4, 7]. Hands-on activities are the more efficient but are difficult to organise for large groups [7]. Libraries must thus find new way to provide first years PBL students with an adapted support in information retrieval. One attractive option is a Web-based tutorial provided in addition to lecture courses [8,9]. Tutorials are software programs that guide the user in a learning process. These programs contain definitions and rules, examples and multiple-choice questions with immediate feedback [10]; they make use of computer's multimedia capabilities and provide some interactivity [11-13]. Web-based systems can reach a large number of users when and where the information is needed [9].

In this work, we designed a Web-based interactive training tool to support the self-acquisition of information retrieval skills. This tool is aimed to the first years medical students of the University of Liege engaged in a PBL-like curriculum.

Material and Methods

The database software used in this project is FileMaker Pro (v.4.1, FileMaker Inc., USA). FileMaker Pro permits the creation of relational multimedia databases and integrates a Webserver. A proprietary tag language, Claris Database Mark-up Language (CDML),allows the databases to be queried from Web pages. Screen copies are obtained using Capture (v.2.01, AnalogX.com). Pictures are resized and saved in GIF format with PhotoShop (v.5.0 LE, Adobe Systems Inc., USA). Multiple links are defined with HomePage (v.3.0, Claris Corp., USA). The WebPages are written HyperText Markup Language v.4.01 (HTML) with HTML-Kit (b.290, Chami.com). The layout of the Web site is defined in an external Cascading Style Sheet (CSS) created with TopStyle Lite (v.2.5, BradSoft.com). Webforms using CDML are elaborated with HomePage.

Results

Tool creation and structure

The Web site is created in HTML 4.01, with little JavaScript; pictures are in GIF format; no proprietary plug-in is necessary. Web

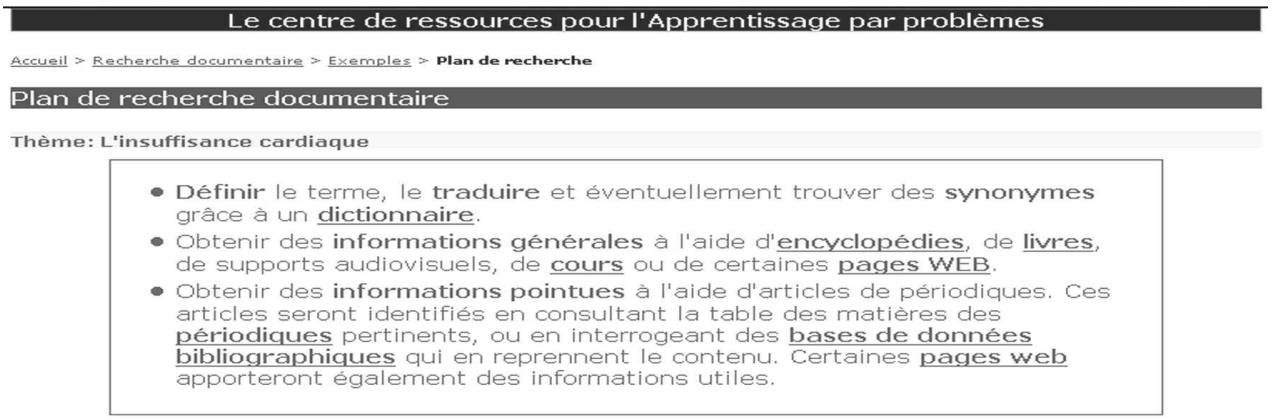

Figure 3: Screen copy of the Search map window

The search map is specific to a theme (here cardiac insufficiency). It provides links to search examples conducted in different resource types.

Figure 4: Screen copy of the Keyword window

Each search example begins with a form asking for a keyword to be searched. The keyword encoded by the user is matched to a list established by the librarians. If relevant, the search is driven forward. If not, the user is directed to dictionaries in order to find a synonym or a translation of the term.

pages compliance is checked with the HTML Validator and the CSS Validator provided by the World Wide Web consortium (w3c.org). The Web site is also regularly previewed with several Web browsers. All the information is stored in databases hosted by FileMaker Pro. Databases are queried with CDML through Web forms.

The tool is constituted of several databases created with FileMaker Pro (Fig.1). The first database contains all information concerning one clinical case. The diagnosis of the clinical case is the theme used for the information retrieval example (Fig.1, link a). The second database, called Search map generator, creates for each resource type a query to the next database named Catalogue of search examples (Fig.1 link b). This database lists and contains a link to all available searches (Fig.1 link c). Each Search example is contained in one database and concerns one theme searched with several keywords in one resource. All the information necessary to provide illustrated guidelines concerning the resource utilisation are encoded in that database. Documents resulting from the searches are catalogued in another database (Fig.1 link d). The Catalogue of selected documents can be accessed directly or from other databases (Fig.1 links e,f). Characteristics of the information resources are contained in one database and shared with others to avoid redundancy (Fig.1 links f,g,h).

Tool administration

Information necessary to create the clinical case is obtained from encyclopaedias, books, articles or WebPages. The operator opens a template database and selects the characteristics of the case from a list of data. Each information, and the related illustration, is then encoded in the database, one per record. The subject, an alphanumerical code from the National Library of Medicine Classification (Bethesda, USA), is used as a key to automatically generate queries to the Search map generator or the Catalogue of documents.

Each search example presents searches on one theme conducted by librarians in one resource. Several search scenarios are considered. Each concerns one pertinent keyword searched with both basic or advanced search options. Depending on the resource, scenarios can be simplistic or complicated (Fig.2). At each step of the searches, the operator takes a screen copy and saves the picture in a file. Later, pictures are modified (resizing, saving in GIF format, image mapping) and renamed following a code. The operator opens a template database. Each record of the database corresponds to one step of the search; the total number of records is then different from one database to another. The theme and the information resource are selected from a reference list. The operator encodes data concerning the screen copy: path to the picture, characteristics of the picture (width, height, links area co-ordinates and title). Each link of the screen copy points to another record of the database that describes the next steps of the search. A French commentary aimed to help the user to progress in the search is also written.

Tool utilisation

The clinical case starts with the patient's main complaint. The user may request additional information concerning the interview or the clinical examination. The information consists of a text accompanied when necessary by a picture such as radiography. The diagnosis is available and contains two related links. The first link provides relevant references from the Catalogue of selected documents. The second link points to the first step of the information retrieval example called "Search Map". The Search Map (Fig.3) is a text that classifies the different types of medical resources in three categories. The first category tools consist in definition and translation dictionaries. Tools of the second category, such as encyclopaedias, books and WebPages, provide basic information on the topic. The third category tools, such as bibliographical databases, periodicals and WebPages, provide advanced information. Each resource type of the Search Map may be clicked on to obtain a list of titles for which examples are provided. Each example begins with a form asking for a keyword to be searched (Fig.4). The keyword encoded by the user is matched to a list establishedby the librarians. If relevant, the search is driven forward. If not, the user is directed to dictionaries in order to find a synonym or a translation of the term. Each step of the search example is illustrated with a screen copy of the original resource and a help text provided by the librarians (Fig.5). To reach the next step, the user must click on the right icon of the screen copy, as he would do with the real resource. Several options may be available. The help text gives

Figure 5: Screen copy of one step of a search example

The screen is divided in two parts. (a) the help commentary provided by librarians, (b) the screen copy with multiple links (see arrows) allowing the user to follow one or another search option.

then useful advice to make a choice. At the end of the search, the user is directed to the full document on the editor's Website. All the documents resulting from the searches are collected and described in a single catalogue.

Discussion

A prototype of a database driven Web-based training tool has been designed on the basis of some PBL pedagogical principles. This tool is aimed at helping students for the self-acquisition of information retrieval skills. Students may thus have access to a complete information retrieval process, from the clinical case to the resulting documents, with search examples conducted by librarians in various document types.

Most of the selected information resources already possess an English user guide developed by the editor or others. These guides mostly provide a single example. If available, interaction is always limited. The layout of the guide is different from one resource to the another. Some consist of HTML pages (text illustrated by some screen copies or reproduction of the HTML layout of the resource); others are constituted of movies or slide shows. These examples are not really suited to propose an integrated Web-based tutorial for French speaking first years students. A specific tool is thus welcome. Web-based tutorials can help to enhance the comprehension of a subject [14]. Reported disadvantages are lack of Internet experience or access [15] or even "computer anxiety" [16]. In 2001, more than 95% of Belgian schools and 36% of families were connected to Internet [17, 18]. An increasing number of new coming students had then already used the Web. Nevertheless, computer instruction is included in the first year of the medical curriculum. For those not adequately equipped, the University of Liege sets up facilities for Internet access, but also for the acquisition of laptop computers.

Learning in context is favoured by PBL-like curriculum. Students generally consider the context as a source of motivation, since they can see the relevance of what they have to learn. [1]. To provide a context for the search examples, we use an clinical case concerning cardiac insufficiency. Students are then directed to the search examples. These searches contain some help provided in different ways by the librarians. First, users receive a Search Map that summarises theoretical information concerning the characteristics of the different types of resources. They have thus the opportunity to use this suggested way of preparing a subject-based information retrieval for their own searches. Later, each step of the searches is commented with a text written in French. This text explains the difference between all available options, and sometimes recommends one of them. Users thus benefit of commentaries and suggestions from specialists, but remain free to select and explore any options.

PBL emphasises clinical reasoning [1]. At the beginning of the search, the user is asked to encode a freely selected keyword. This feature favours reasoning since the user must find a pertinent keyword for the subject of the clinical case.

With Problem-based learning, students have to construct their knowledge by themselves. This knowledge is based on their previous knowledge, completed by interactions between material or persons. [19, 20]. Web-based tutorials must then provide activities that are as close as possible to the authentic resource [19]. In our tool, each step of the search examples is illustrated with a screen copy of the original resource. The screen copies contain clickable areas (image maps). The user must click on icons of the screen copy to reach a further step of the tutorial. This makes the student familiar with the real resource interface. The navigation in the real resource will then be easier since the user has already discovered the functions of the icons with the search examples.

Students must now test the efficiency and the user friendliness of the prototype. This will help us to improve the usability of the training tool.

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